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A MANUAL OF SURGERY

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Manual of Surgery

BY

CHARLES STONHAM, F.R.C.S.Eng.

SENIOR SURGEON TO THE WESTMINSTER HOSPITAL; LECTURER ON SURGERY AND ON CLINICAL
SURGERY, AND TEACHER OF OPERATIVE SURGERY, WESTMINSTER HOSPITAL; SURGEON
TO THE POPLAR HOSPITAL FOR ACCIDENTS; EXAMINER IN SURGERY, SOCIETY
OF APOTHECARIES, LONDON; LATE MEMBER OF THE BOARD OF
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SCHEME FOR ENGLAND, ETC. ETC.

IN THREE VOLUMES

VOL. III.—REGIONAL SURGERY

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CHAPTER I

DISEASES OF THE BLOOD-VESSELS

HÆMOPHILIA[1]

Etiology.—The hæmorrhagic diathesis is hereditary, being transmitted through females to males, who suffer much more commonly and severely from the hæmorrhages characteristic of this condition. The disease, should it manifest itself in women, does so in a very modified and much less dangerous form. Having said that the disease is hereditary, we have practically said all that is known as regards its causation, for no deterioration of the general health is observable other than that which may be induced by profuse hæmorrhage; nor does *post-mortem* examination reveal any abnormal condition of the vessels or tissues. The pathology is practically unknown.

Symptoms.—The disease manifests itself in the first years of life—rarely after the tenth—and is characterised by capillary hæmorrhages from the mucous membranes, into the various cavities of the body and beneath the skin, and by certain changes in the joints. The hæmorrhages may be distinctly traumatic (*e.g.* tooth extraction), or may occur spontaneously. The bleeding varies in its amount and persistency; in some cases it may be so great as to prove fatal, whilst in others the patient suffers profuse and repeated bleedings from the mucous membranes and falls into a state of profound anæmia. Yet it is remarkable how quickly these patients recover from even the smartest hæmorrhage. In bad cases hæmorrhage may occur in the brain and in various organs and cavities of the body. In the case of women the disease may manifest itself by profuse bleeding at the menstrual period, or by purpuric extravasations underneath the skin.

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[1] Hæmophilia is dealt with here as being more convenient, although it can hardly be said to be a disease of the blood-vessels.

Joint affections.—Hæmarthrosis may occur from such slight causes as to appear almost spontaneous. Blood is effused into the synovial membrane and into the joint cavity. The joint is painful and tender, but there is no increased heat; the blood may become absorbed, or the joint may remain somewhat swollen and tender. Further hæmorrhages occur from time to time; the cartilages become eroded and a low form of chronic inflammation ensues, which partakes of the nature of osteo-arthritis and results in the formation of adhesions. The knee, elbow, and ankle are the usual seats of the mischief.

Diagnosis.—The diagnosis usually presents no difficulty, and the importance of arriving at it cannot be over-estimated. Bleeders are usually well aware of their inheritance of this condition, which is, so to speak, a family heirloom.

Treatment.—General treatment appears to be useless; the most that can be done is to avoid all causes which may promote hæmorrhage, and above all, not to perform even the slightest surgical operation upon the subject of hæmophilia. The extraction of teeth is particularly dangerous. If bleeding occurs, the use of cold and well-applied pressure are the best and safest means of arresting it. Ordinary styptics, and above all, the use of the cautery, must be carefully avoided, since both are liable to cause sloughing of the tissues and profuse hæmorrhage at the time of separation of the sloughs. Almroth Wright, with a view to increasing the coagulability of the blood, recommends the use of tissue-fibrinogen, obtained from the thymus gland and dissolved by the addition of a few drops of a dilute solution of carbonate of soda. A plug of cotton wool saturated with the solution is to be applied to the bleeding area. The firmness of the coagulum may be increased by the use of a 1 per cent solution of calcium chloride. Calcium chloride and camphor are also recommended for internal use in the general treatment of the disease, the latter it is stated increases the number of white corpuscles, and hence the amount of fibrin-forming material. Hæmorrhage into the joints must be treated by complete rest, the application of the ice-bag, and gentle uniform pressure; aspiration is not permissible, nor should any attempt be made to forcibly move the joint should adhesions result.

ANGEIOMATA

CIRSOID ANEURISM—ANEURISM BY ANASTOMOSIS—ARTERIAL VARIX

A cirsoid aneurism is an angeioma formed of dilated, elongated, and tortuous arteries, the walls of which are thinned from atrophy of the middle coat. If the vessels communicate with dilated and tortuous capillaries and veins, the condition is spoken of as aneurism by anastomosis. Arterial varix is the name applied to the change when it affects a single artery.

Cirsoid aneurism may be met with in any region of the body, but is most common in connection with the temporal and occipital arteries (Fig. 1, p. 4). It is probable that most cases are congenital in origin, although the tumour does not usually attract attention until about the age of puberty.

Signs.—The tumour is soft, compressible, and pulsatile, and there may be a systolic thrill and bruit of which the patient is sometimes quite conscious when the tumour is situate on the scalp or in the orbit. The dilated arteries may be distinctly felt as pulsatile cords, and large varicose veins may be plainly visible. The overlying skin is of a bluish colour and somewhat hotter than elsewhere.

In some cases the skin is thickened and pigmented, in others thinned and perhaps ulcerated; if the ulceration extends deeply, very severe and dangerous hæmorrhage may ensue. Cirsoid aneurism, having attained a certain size, may remain stationary without inducing any symptoms necessitating active treatment; more usually it steadily progresses in size.

Treatment.—Unless the tumour rapidly increases, or ulceration of the skin with dangerous bleeding demands radical treatment, it is not advisable to do more than afford efficient protection by means of a vulcanite or celluloid shield. Many plans for effecting cure have been practised, but some of these are so dangerous and uncertain that they have been practically abandoned. Difficulty of cure is great, especially in places, *e.g.* the scalp, where the normal arterial supply is abundant and the anastomoses free.

If the aneurism is small it should be completely removed by **excision**, each vessel being carefully secured as it is divided. When excision is not deemed advisable an attempt may be made to obliterate the vessels by **electrolysis**, a strong current being used and the operation repeated if necessary.

Ligature of the aneurism by the method formerly employed for nævi is only suitable when the tumour is small, and under these circumstances excision is practicable and the best treatment.

Ligature of the individual vessels is useless, since it is impossible to secure those entering the deep surface of the growth, circulation through which keeps up the condition. In the case of cirsoid aneurism of the scalp, ligature of both external carotids may be tried if excision is unadvisable and electrolysis fails. Treatment by coagulating injections is mentioned only to be condemned.

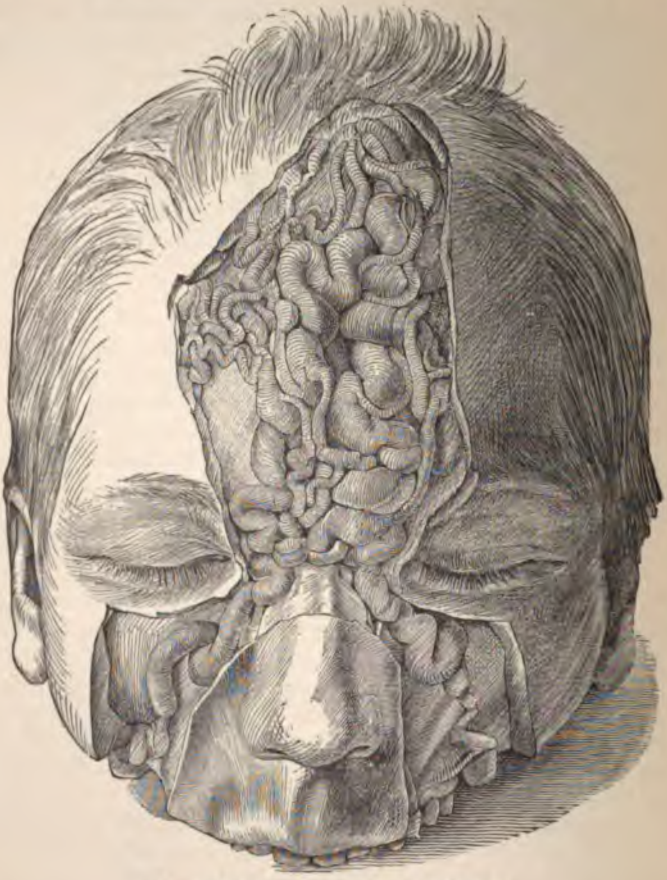

FIG. 1.—Cirsoid aneurism of the scalp (Ziegler).

NÆVI

Nævi are tumours composed of blood-vessels, and are partly formed by dilatation and thickening of the walls of those normal to the part, and partly by vessels of new formation. Nævi are practically almost always congenital tumours, but in some situations, *e.g.* the liver, they are said to occur in later life.

Distribution.—Nævi are common in the skin and subcutaneous tissue, especially about the scalp, face, and trunk. They are also met with in the tongue, rectum, orbit, liver, spleen, and kidneys, but in the last three situations do not give rise to symptoms. It is probable that some cases of varicocele and varicose veins ought to be regarded as instances of venous nævi.

Varieties and morbid anatomy—**The capillary nævus** consists of dilated and tortuous capillaries of the skin, with a supporting framework of connective tissue. Minute arteries supply the affected area, which is often very large, and especially affects the face, giving rise to the "port-wine" stain. The surface is slightly raised and the colour varies from deep red to purple; it disappears on pressure and immediately returns. The capillary nævus may form a small, raised, bluish or purplish patch, and is often associated with the venous variety.

The venous nævus is composed of large or small cavernous spaces lined with endothelium like that in the vessels, but having no definite vessel wall. The spaces are separated by connective tissue, and the whole tumour is frequently invested by a delicate capsule. Arterial branches supply the mass and communicate with the venous channels without the intervention of capillaries. On section such tumours resemble the structure of the corpus cavernosum. Usually the venous nævus is quite localised, but sometimes it is widespread and largely composed of fat and connective tissue (*nævo-lipoma*); such tumours may be met with in or between the muscles, and in the cheek, and may give rise to considerable difficulty in diagnosis.

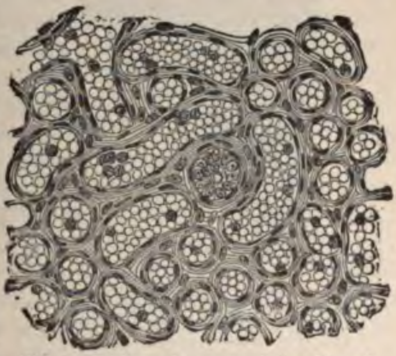

FIG. 2.—Section of a nævus of the skin and subcutaneous tissue (Ziegler).

Enlargement of a limb or part of a limb is sometimes met with as a congenital condition; this is due to a great increase in the fat and connective tissue, with enormous enlargement of the veins and dilatation of the capillaries of the skin.

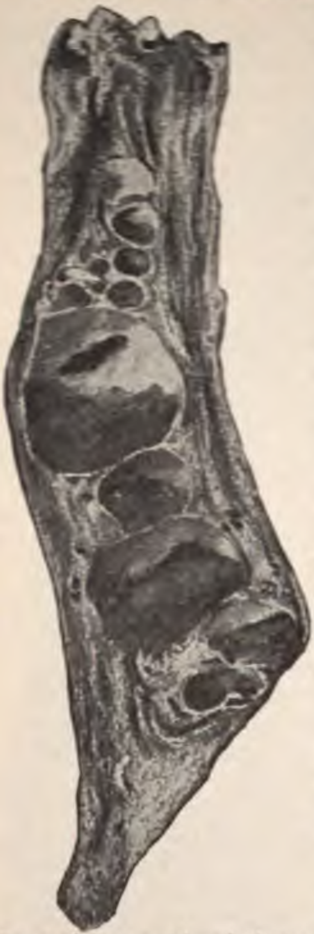

FIG. 3.—Cavernous angioma in the substance of the gracilis muscle. The patient was a young lady aged twenty-two. The tumour was observed seven years before the muscle was removed; it had recently rapidly enlarged and formed a lobulated mass extending nearly the whole length of the muscle (Westminster Hospital Museum, No. 383).

Venous nævi may gradually increase in size, remain stationary, or gradually atrophy; they may become fatty, degenerate and become cystic, ulcerate and bleed, or develop sarcomatous properties.

Signs.—Venous nævi are usually situated beneath the skin, but may be deeply placed between the muscles. The tumour is soft, easily compressible, and becomes engorged and swollen in proportion to the tension of the blood stream. The overlying skin may be quite normal, or may be the seat of the capillary form of nævus; dilated veins are sometimes seen coursing in it. Subcutaneous venous nævus may be mistaken for a lipoma, a mistake of not very great importance, since both are best treated by excision. A large venous nævus, especially if some of the vessels are cystic, may have a distinct continuous and diagnostic thrill; Fig. 3 represents a very large cystic venous tumour of the gracilis muscle.

Treatment. — The ordinary port-wine stain should be left alone. Small capillary and venous nævi may be successfully cured by **electrolysis**; the current should be weak (about 10-12 Leclanché cells), and should be continued for about ten minutes. The negative pole should be placed on the skin and the positive in the nævus. If the current be too strong, indicated by the evolution of gas and by actual charring of the skin, suppuration and sloughing may result. The nævus, if large, should be cured in sections.

Excision is the best treatment, provided it can be effectually done and the nævus is not very large. Bleeding is free, but is easily arrested by pressure and ligature; the whole nævoid area must be removed.

Ligature is practically obsolete, as it offers no advantage and several disadvantages as compared with excision or electrolysis.

Very small nævi may be obliterated by nitric acid or Paquelin's cautery, but electrolysis is preferable.

Vaccination, coagulating injections, and other means which have been suggested for the cure of nævi, are no longer practised in view of more certain or less dangerous methods.

DISEASES OF THE VEINS

THROMBOSIS

Definition.—When a vessel is blocked by blood-clot it is said to be thrombosed; the clot is known as a thrombus, and the process as thrombosis.

Etiology.—Thrombosis may be due to constitutional or local conditions, to disease or injury of the vessel wall, to some altered state of the blood, or to retardation of its flow. Any **constitutional condition** causing great prostration and anæmia may lead to "marasmic thrombosis," which commonly affects the superior longitudinal sinus. Such conditions act partly by lessening the force of the circulation and thus favouring stasis, and partly perhaps by increasing the amount of fibrin-ferment, and hence the coagulability of the blood. Gout is a common cause, probably inducing thrombosis as a secondary consequence of gouty phlebitis.

Local conditions may act by causing stasis of the blood stream or by inducing some change in the vessel walls. Thus, compression from without causes stasis and subsequent thrombosis.

Changes in the vessel walls.—The conditions of the vessel wall which may lead to thrombosis are (1) injury of any kind, including the presence of a foreign body; (2) inflammation of a simple or infective nature; or (3) any degenerative change in the vessel wall.

Changes in the blood.—If the blood contains an excess of fibrin-ferment, coagulation is favoured. In the infective processes the ferment is freed by the destruction of the leucocytes, and hence thrombosis is favoured independently of the phlebitis, which may occur from direct infection of the wall (see p. 13).

Retardation of the blood flow is a common factor in the production of thrombosis, and may be due (1) to failure of the propulsive forces of the circulation; (2) to varicosity of the vessels; or (3) to external pressure.

Morbid anatomy and results.—The formation of a thrombus may be effected quickly or gradually. If thrombosis occurs suddenly, the fibrin entangles the corpuscles in its meshes, and the clot is of an uniform red colour like ordinary coagulum (red thrombus); but if the process of coagulation is slow, very few red cells are thus entangled and the clot is more or less decolorised (white thrombus). Intermediate stages are often seen, more or less of the red cells being present in the clot. If rapidly formed, the clot is not intimately adherent to the vessel wall, nor is it laminated, but with advancing age it comes to resemble the white clot from disintegration of the red cells.

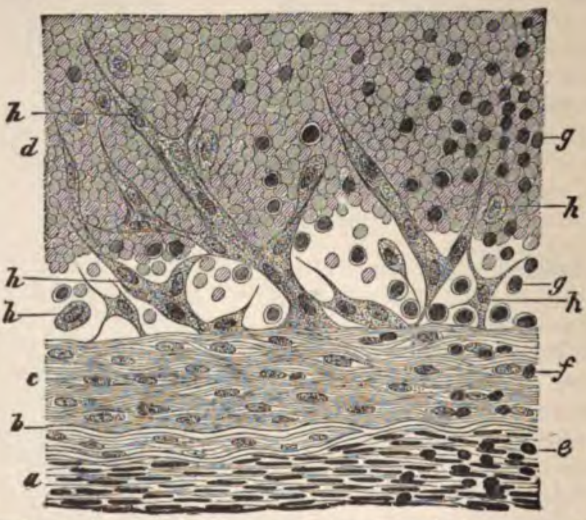

FIG. 4.—Section of a thrombus in process of organisation. (From the femoral artery of an aged man three weeks after ligature: hæmatoxylin staining: × 350.) *a*, tunica media; *b*, fenestrated elastic membrane; *c*, intima thickened by previous inflammation; *d*, coagulated blood; *e*, cells infiltrating the media; *f*, cells infiltrating the intima; *g*, leucocytes, partly within the thrombus, partly between it and the intima; *h*, various kinds of formative cells (Ziegler).

Post-mortem clots may be distinguished from those formed during life by the following features:—They are jelly-like in appearance, do not completely fill the vessel, are not adherent to its walls, and are most deeply coloured at the dependent parts, the least so being partly decolorised; such clots often extend a long distance into the collateral channels, and may be readily pulled out of the vessels, of which they form an incomplete cast. The extent of thrombosis depends in great measure on its cause; in cases due to injury it is usually arrested at the next branch, but in infective cases it may spread indefinitely.

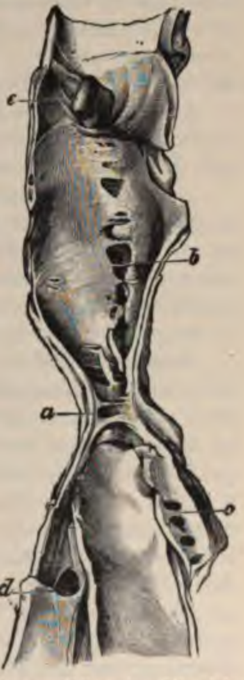

FIG. 5.—Obliteration of the right femoral vein (Ziegler). *a*, point of obliteration; *b*, *c*, *d*, fibrous bands within the vein and its branches; *e*, recent thrombus.

One of the following changes may occur in the coagulum:—

(1) The thrombus may undergo *red softening* and gradual disintegration. The lumen of the vessel is re-established and the particles, being washed away into the blood stream, do no harm, as they are very small and non-infective.

(2) *Organisation.* The clot becomes paler in colour and is infiltrated with leucocytes and lymph, which gradually replace its substance and remove it by absorption. New vascular channels are formed and the clot is replaced by fibrous tissue, as described in chapter v. p. 70, vol. ii.

The new tissue is intimately blended with the vessel wall, and finally both contract, become indistinguishable, and the obliterated vessel is represented by a mere fibrous cord.

Sometimes the process of organisation is not quite complete, and spaces and channels persist so that the blood stream may be maintained.

(3) Portions of the clot may become *infiltrated with lime salts*, and small calcareous nodules or phleboliths result.

(4) *Yellow softening and disintegration.* If a thrombus possesses infective properties, it undergoes yellow softening, and serious results ensue. The central parts break down, forming a purulent-looking material composed of disintegrated clot, pus cells, and micro-organisms. This process extending throughout the clot leads to its total destruction, and the detritus is carried by the blood stream

to distant parts in the form of emboli, which, as they possess infective properties, excite secondary centres of inflammation wherever they lodge (see chap. x. p. 217, vol. i.).

Sometimes the peripheral portions of the thrombus are not infected and may not disintegrate; under such circumstances a local abscess results, the vessel wall softens, and the inflammatory process extends to the surrounding structures, but the general blood stream is not contaminated, since the ends of the clot remain stable and prevent the infective material passing into it (p. 228).

(5) *Embolism.* A simple clot may break away and become impacted in some distant vessel. The result depends on its size and the situation in which it lodges.

Arterial embolism acts mechanically by cutting off the blood supply. The effect of this depends upon the facilities for carrying on the circulation by means of collateral channels; if this be deficient, gangrene may result. Cerebral and pulmonary embolism produce serious effects on account of the important vital functions of the parts affected.

Venous embolism.—When an embolus originates from a venous thrombus it is carried (except in the case of the portal vein) to the right side of the heart and thence into the lungs. If the embolus be large enough to obstruct the main pulmonary artery, instant death results. In most cases the emboli are small and pass to the terminal ramifications of the artery in the lung, producing a hæmorrhagic infarct. The effects produced by a non-infective embolus are limited to the area supplied by the obstructed vessel. An infarct in the lung is wedge-shaped, with the base at the periphery. At first it is jelly-like in colour and appearance, but gradually becomes paler and smaller, the extravasated blood is absorbed, and the whole area cicatrises and shrinks.

Infective emboli cause acute suppuration wherever they lodge.

The signs and treatment of thrombosis are practically those of phlebitis (p. 12).

PHLEBITIS

Etiology.—The etiology of phlebitis is that of thrombosis. These two conditions should practically be considered together, since they are almost always associated, although thrombosis may sometimes occur without exciting phlebitis. Inflammation of a vein may be due to some change in its coats or in its surrounding cellular tissue, or to the formation of a thrombus in consequence of some altered blood state, or arrest of the circulation.

Changes in the coats of the vessel.—Contusion or injury of a vein may induce a simple inflammation leading to thrombosis. After ligature this process aids in producing permanent occlusion.

Varicosity alters the condition of the vein walls, and this, added to the deficient rate of the blood-flow, is especially prone to induce phlebitis and thrombosis.

Chronic inflammation of the walls of veins, of a similar nature to that met with in arteries, may sometimes occur, but is not common and never extensive.

Syphilis and tubercle occasionally affect the coats, and gout probably induces phlebitis by leading to changes in them.

Changes outside the vein.—Inflammation of a simple, septic, or infective nature occurring in the neighbourhood of a vein may spread to its walls. The effects produced will depend upon the nature of the inflammation; if this be simple, the resulting phlebitis is quite localised, and the thrombus may become absorbed or organised. If, however, the primary inflammation is dependent upon the action of a septic or infective poison, the vein participates, and the disease usually spreads rapidly along its course, involving the tributaries in its path; the thrombus breaks down, suppuration ensues, and general embolic infection may terminate the case (see p. 13).

Alterations in the blood.—The septic diseases produce alterations in the blood whereby its coagulability is increased, and thrombosis may occur in the veins. When a simple, unirritating thrombus is present in a vein it does not necessarily lead to any changes of an inflammatory nature; but if a thrombus be possessed of septic properties, inflammation of a spreading nature ensues, leading to suppuration and softening of the wall. It is in this way that the most serious forms of phlebitis arise, rapidly spreading along the vein and giving rise to secondary centres of destructive inflammation consequent on the breaking down of the clot and the lodgment of infective emboli in distant vessels (chap. x. p. 217, vol. i.).

Stasis of the blood stream occasions thrombosis and secondary phlebitis.

Morbid anatomy of phlebitis.—The coats of the vein are injected and infiltrated with leucocytes and lymph, and there is a certain amount of effusion and consequent œdema into the adjacent cellular tissue (*periphlebitis*). The endothelial cells soon become to distant parts in the form of emboli, which as [illegible] fective properties, excite secondary centres of inflamm[illegible] mischief, they lodge (see chap. x. p. 217, vol. i.). [illegible] but if

Sometimes the peripheral portions of the th[illegible] ally, the infected and may not disintegrate; under such [illegible] occurs in local abscess results, the vessel wall softens, and [illegible] depends upon process extends to the surrounding structure[illegible] blood stream is not contaminated, since the [illegible] is the case; stable and prevent the infective material passin[illegible] of the

(5) *Embolism.* A simple clot may b[illegible] perhaps impacted in some distant vessel. The resul[illegible] of the and the situation in which it lodges.

Arterial embolism acts mechanicall[illegible] supply. The effect of this depends u[illegible] on the circulation by means of coll[illegible] deficient, gangrene may result. Cer[illegible] produce serious effects on account of [illegible] of the parts affected.

Venous embolism.—When an [illegible] thrombus it is carried (except in th[illegible] right side of the heart and thence [illegible] be large enough to obstruct th[illegible] death results. In most cases th[illegible] terminal ramifications of th[illegible] hæmorrhagic infarct. The [illegible] embolus are limited to the [illegible] An infarct in the lung [illegible] periphery. At first it is [illegible] gradually becomes paler [illegible] absorbed, and the whole [illegible]

Infective emboli [illegible] lodge.

The signs and tr[illegible] of phlebitis (p. 12).

[illegible]

Etiology.—[illegible] These two con[illegible] since they are [illegible] sometimes [illegible] vein may be [illegible]

be encouraged by cold
current.

presence of
from without,
caused coagula-
bitis is secondary.
so does the danger
in some cases the pro-
and general embolic in-
local abscess results, and
short; while in a third class
is a good example, the process
along the veins but rarely leads
the legs may remain congested and
period, and cutaneous ulceration is
multiple and intractable. The local
as those of adhesive phlebitis, but
more marked. Constitutional disturb-
of the absorption of toxines from the
ondary embolic centres in the lungs and
general disturbance. Unless the process can
general infection will occur in most cases.
The treatment of infective phlebitis is that
as being applicable to infective thrombosis of
nous sinuses, but unfortunately in many cases
extent of the affected veins do not permit of
al treatment, and in these local antiseptic measures
together with the treatment necessary for general
this occur (see chap. x. p. 215, vol. i.).

VARICOSE VEINS—VARIX

nition.—Permanent dilatation and elongation of a vein,
ation in the structure of its walls, constitutes varix.
special veins sometimes receives distinctive names, *e.g.*
oids, varicocele.

tiology.—Varicosity is dependent upon conditions causing
rease in the intravenous blood pressure, or diminution of the
ting power of the vessel walls. In some instances varix is

distinctly hereditary, and occurs in many members of the same family; in such it seems probable that the walls of the abnormally numerous veins are weak owing to some developmental defect, the condition being closely allied to nævus. In acquired cases, increased blood pressure plays a far more important part in the etiology than does diminished resistance of the vessel walls.

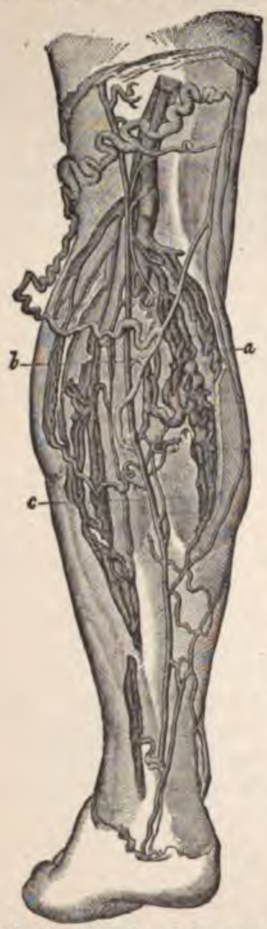

FIG. 6.—Varicosity of the superficial and deep veins of the calf. *a*, superficial veins; *b*, deep veins; *c*, deep fascia. From a specimen of Verneuil's in the Musée Dupuytren (Follin).

Such increased pressure may be due to general or local interference with the proper venous blood current. Cardiac disease and obstruction in the pulmonary circulation act indirectly throughout the whole venous system; portal obstruction is a cause of dilatation of the hæmorrhoidal veins.

Varicose veins in the leg may be due to increased pressure on the pelvic veins, as in repeated pregnancies; to compression by tight garters, long standing, or to obstruction of the main veins, either from external pressure, or from thrombosis and permanent obliteration.

Morbid anatomy.—A varicose vein is dilated and elongated, and consequently coiled and tortuous. The dilatation is unequal, and is usually greatest just on the cardiac side of the valves, where saccular pouches of considerable size may form; sacculi may also be present where a vein joins the main trunk, *e.g.* the upper end of the saphenous. Since the valves do not increase in size they are, in view of the dilatation, rendered incompetent, and may completely atrophy or be represented by mere fibrous bands; hence the weight of the column of blood aggravates the condition of varicosity.

Varicose veins may be very much elongated and coiled, the separate coils being united by connective tissue.

The walls of the vein are thickened by chronic inflammation, the thickening chiefly affecting the inner and middle coats; this renders the wall inelastic and rigid, so that the vein when cut across, instead of collapsing, remains open like an artery. The thickening, like the dilatation, is unequally distributed; where a vein is immediately beneath the skin, or at the bottom of an ulcer, or where it forms a sacculus, the wall may be unduly thin from atrophy, and if it rupture profuse hæmorrhage occurs. Very rarely the vein is the seat of atheroma or calcareous degeneration.

Secondary thrombosis and phlebitis is by no means uncommon.

Distribution.—Varix is most common in veins which, from their superficial or dependent position, loose cellular surroundings, or absence of valves, are liable to chronic over-distension, and are less able to withstand it; the saphenous, hæmorrhoidal, and the veins of the pampiniform plexus, are those chiefly requiring surgical treatment; the veins of the posterior pharyngeal wall are often varicose. The deeply-seated posterior tibial veins are frequently varicose, and where a deep vein joins a superficial one dilatation is often marked, since the blood stream, driven onwards during muscular contraction, is checked by the column of blood at the junction.

Signs and results.—Varix of superficial veins is easily recognised; the dilated and tortuous vessels stand prominently out, especially if the blood-stream is arrested by pressure on the cardiac side, where the vein joins the main trunk, and especially also if there be a sacculus at this point—a distinct thrill and impulse often being felt when the patient coughs. If the varicosity is slight the patient may not experience any inconvenience, but in marked cases there is a sense of weight, discomfort, and aching; œdema of the leg is common, especially at night and after walking.

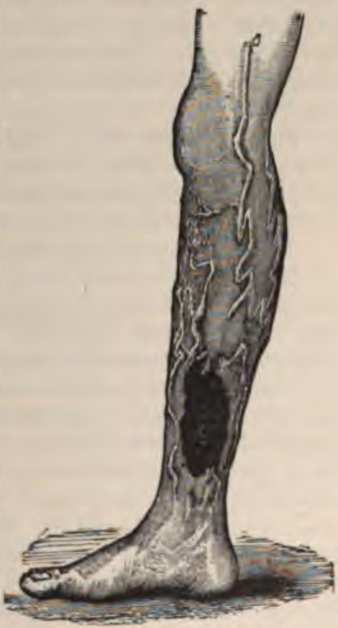

FIG. 7.—Varicose ulcer (*a*) with varicose veins of the leg (Tillmans).

When the condition has been present for some time there is chronic congestion and imperfect nutrition of the parts involved, and hence chronic eczema with pigmentation of the skin, or indolent ulceration (Fig. 7, p. 15) with considerable overgrowth of fibrous tissue may result from very slight causes (see Varicose Ulcer, chap. iv. vol. i.). Rupture of a vein, thrombosis, and phlebitis may all occur.

Treatment.—When varicosity is dependent upon some general or local condition which cannot itself be removed, no curative treatment is to be undertaken, since the venous dilatation is, as it were, a compensatory enlargement to relieve the circulation.

Palliative treatment is all that is necessary in mild cases which cause no inconvenience. The patient should wear an elastic support, except at night; long standing and too much walking must be avoided, and the legs should be elevated when the patient sits down. Cold douching and gentle friction towards the heart are very beneficial. The bowels must be carefully regulated, and good food, tonics, and stimulants given according to the circumstances of the case.

Radical cure is indicated when the veins cause pain and annoyance, and when chronic eczema or ulceration are present, provided that the age and general condition of the patient do not contra-indicate operative treatment.

The only operation to be advised is excision.

If the varix is limited to a certain portion of a vein, it may be completely excised through one incision, but when, as is so often the case in the internal saphenous vein, a long area is involved, several portions may be cut out along the course of the vein.

The points to be excised should be carefully marked out before the operation, care being taken that sacculi are removed, and that collateral and dilated branches are included. The wounds should be closed with horse-hair, and a dry antiseptic dressing applied, the limb slightly raised and left untouched for a week or ten days, when the wounds will be found healed. The patient should remain in bed for at least a fortnight to ensure perfect obliteration. If a varicose ulcer is present, it should be thoroughly cleaned before the operation; when this is completed, the ulcer should be dressed antiseptically, and may be left alone until it is time to dress the operation wounds. A small ulcer may be found quite healed at the end of ten days, and large ones will be very much improved; the patient should, however, be kept in bed until healing is complete. After excision of varicose veins, the patient should be instructed to wear an elastic stocking.

Varicose veins of the pharyngeal wall should be treated by the galvano-cautery.

DISEASES OF THE ARTERIES

Anatomy.—Arteries consist of three coats, the united thickness of which is relatively greater in the small than in the large vessels. The outer coat is composed of connective tissue with numerous elastic fibres; the middle coat, to which the chief thickness of the vessel is due, is formed of circular muscular fibres, passing between the bundles of which are numerous elastic fibrils and some connective tissue. The inner coat, where it joins the middle, consists of elastic tissue (the fenestrated membrane of Henle); the remainder, excluding the layer of flattened endothelial cells lining the inner surface, being made up of connective tissue and elastic fibres. The vasa-vasorum ramify in the outer and penetrate into the middle coat, but do not reach the inner. Arteries are surrounded by areolar tissue forming the so-called sheath; in the case of the larger vessels the fascia of the part itself forms a distinct membranous sheath for the vessels. Arteries are possessed of considerable strength, and, especially the larger ones, are very elastic; they are stretched longitudinally, and the blood within them distends the elastic coats circumferentially.

ARTERIAL DEGENERATION

Fatty degeneration is met with at any age, and is often widespread. Its causes are unknown. Affecting chiefly the large vessels, the fatty change occurs in the sub-endothelial cells, and sometimes extends to the middle coat. The fatty areas are seen as small dots and streaks of a pale yellow colour, hardly raised above the surface; they are quite smooth, owing to persistence of the endothelial cells.

Results.—As a rule the change is not extensive enough to give rise to any ill effects; but in some cases, especially if the muscular coat participates, the softened area yields transversely, and the blood finds its way between the layers of the middle coat (*dissecting aneurism*). Complete rupture of the vessel wall is rare, except in the case of the cerebral vessels of the aged, in which fatty changes are found throughout the thickness of the wall.

Calcareous degeneration.—In advancing age the muscular coats of arteries of the third and fourth magnitudes, especially those below the knee and elbow, often become calcareous. The change is symmetrical on the two sides. The lime salts are first deposited in the neighbourhood of the cell nuclei, and ultimately entirely replace the cells, which form delicate calcareous lines running transversely to the long axis of the vessel. By an extension of the process rings of calcareous matter encircle the artery (*annular calcification*), which by their coalescence is converted into a rigid cylinder (*tubular calcification*). The inner and outer coats are at first unaffected, but eventually participate in the change, though to a less extent. When the inner coat is diseased, the endothelium may disappear, and the blood being in contact with the roughened wall, thrombosis may ensue. Calcareous vessels are rigid, inelastic, and brittle; the lumen is diminished, and the circulation impeded.

Results.—The subjects of arterial degeneration complain of coldness, numbness, and blueness of the parts supplied by the affected vessels, and unless efficient means be adopted to promote circulation and maintain warmth, gangrene may occur, and will probably do so should the vessels become thrombosed. The superficial vessels may be felt as tortuous, inelastic, unyielding tubes, the pulsation of which is very feeble. Wounds inflicted on the tissues heal slowly, or slough in consequence of the impaired vitality.

Calcified arteries do not become aneurismal, for their walls are more rigid than normal, and the force of the circulation is diminished in advanced life. They may, under proper antiseptic precautions, be ligatured with comparative safety, provided the outer coat be not affected; it is upon the integrity of the latter that the surgeon relies for safety after the application of a ligature to such vessels.

Treatment.—The limbs must be protected against cold, and should be warmly clad with wool; circulation may be encouraged by gentle friction and the elevated position. The general health must be maintained by good and nutritious food, with a moderate supply of alcoholic stimulants. Digitalis and opium are very useful if cardiac weakness is pronounced.

INFLAMMATORY AFFECTIONS OF THE ARTERIES

ACUTE ARTERITIS

Causes.—Acute arteritis of primary origin is now known not to occur, the morbid appearances formerly regarded as indicative of such a condition being due to *post-mortem* staining. Localised arteritis may result from injury, from the extension of inflammation from neighbouring parts, or from the impaction of an infective embolus, especially in cases of acute ulcerative endocarditis. The continuous irritation of a sequestrum or foreign body in the neighbourhood of an artery may excite local inflammation with softening of the coats.

Morbid anatomy.—Acute arteritis begins, according to its cause, in the intima (*endarteritis*), or in the outer coat or sheath (*periarteritis*). The affected coat is infiltrated by cellular exudation; and the endothelium, which is at first intact, proliferates and is shed, leaving a roughened surface on which fibrin becomes deposited. This sometimes leads to complete thrombosis and permanent obstruction. In other cases, especially those consequent on some infective process, the arterial coats rapidly soften and disintegrate, and by yielding to the force of the blood stream, produce hæmorrhage; this was formerly a frequent cause of secondary hæmorrhage. Arteritis due to injury, *e.g.* ligature, or to the lodgment of a non-infective embolus, does not lead to such serious results, the inflammation being of the adhesive type and causing permanent obliteration of the vessel. In acute endarteritis the interior of the vessel is studded with small, pink, gelatinous patches which are slightly raised above the surface, and are due to exudation into the subendothelial tissue. The endothelium itself is not destroyed, unless the process continues and leads to destruction.

Results.—According to the circumstances inducing it, arteritis may lead to (1) permanent obliteration of the vessel; (2) thrombosis; (3) gangrene (especially if the companion vein be diseased); (4) softening and rupture of the walls; or (5) gradual dilatation and the formation of an aneurismal sac.

Treatment.—The treatment must be directed to the removal and avoidance of causes of the condition. The maintenance of asepsis is, in the case of wounds, the great preventive measure. In foul and sloughy wounds, where there is a probability of extension of the inflammation to the arterial coat, every precaution must be taken to deal with secondary hæmorrhage should it occur. In embolic arteritis care should be taken to promote collateral circulation and avoid gangrene.

CHRONIC ARTERITIS

Chronic arteritis is much more common than the acute disease, and occurs in three chief forms:—

Spreading obliterative arteritis—Arteritis obliterans—Endarteritis proliferans—Hyperplastic endarteritis

The condition indicated by the above names is rare, and its causation unknown, it being distinct in some respects from gummatous arteritis. The disease usually occurs about middle life, but sometimes much earlier, the patient being generally healthy in other respects.

Morbid anatomy.—There is cellular proliferation of the inner coat, with gradual narrowing of the calibre of the vessel and ultimate obliteration, which may be hastened by thrombosis. The disease may spread to the middle and outer coats. The new tissue and the thrombus, if such be present, are nourished by new vessels developed from the vasa-vasorum; as organisation proceeds, the whole vessel becomes converted into a dense fibrous cord. Beginning in the smaller peripheral vessels, the disease tends to spread upwards to the main trunks, which may be obliterated. In consequence of the interference with the circulation, serious trophic lesions may result, *e.g.* gangrene.

Signs.—During the progress of the arterial change, pain, coldness, blueness, and numbness are complained of in the fingers or toes, as the case may be. The pain may be very severe, especially at night. Muscular weakness is also present. The vessels can be felt as hard, incompressible, and pulseless cords, while the pulse above the obliterated portion is more forcible than normal.

In the course of time intractable ulcers and patches of dry gangrene result. The gangrene does not, however, extend very far, but may attack all the digits. The general signs of this disease are very similar to those met with in Raynaud's disease (see chap. v. vol. i.).

Treatment.—The affected parts must be kept warm and pain may be alleviated by bathing with warm water, or if severe enough, by the injection of morphia. Gangrenous parts should be allowed to separate spontaneously, unless the gangrene is extensive, in which case amputation should be performed when separation is well advanced. Iodide of potassium may be given if syphilis is suspected although this disease has not been shown to be a causative factor. No drug has any direct beneficial effect.

Syphilitic Endarteritis

Tertiary syphilis induces certain changes in the smaller arteries, especially those of the brain, kidney, and other viscera. Similar effects are met with in the vessels of gummatous deposits. Acquired and congenital syphilis are alike responsible for these changes. Atheroma of the larger vessels is doubtless predisposed to by syphilis, but this condition—to be presently considered—is distinct from that directly due to the dyscrasia.

Morbid anatomy.—The chronic inflammation begins in the intima and adventitia, and after a time, invades the muscular coat. It occurs in isolated patches (gummata) beneath the unaffected endothelial lining. The endothelial cells proliferate and multiply and leucocytes escape from the vasa-vasorum.

This cellular accumulation causes thickening of the intima, which projects into, narrows, and alters the shape of the lumen of the vessel. The cells, which are imperfectly vascularised by new vessels derived from the vasa-vasorum, develop into connective tissue, bounded internally by endothelium and a layer of newly developed elastic tissue.

Caseation may occur, but is quite exceptional. The affected vessel is opaque white in colour, rigid, inelastic, contracted, and tortuous by reason of the unequal distribution of the change. The narrowed lumen may become quite obliterated, and the vessel be reduced to a mere fibrous cord; these changes are in marked contrast to the weakening and tendency to become aneurismal which occurs in cases of atheroma. In some cases thrombosis occurs.

The effects are those dependent upon interference with the blood supply. In the case of the brain the diseased vessels may rupture under the blood pressure. The vessels of gummata, few in number, undergo the syphilitic change above described, and are consequently incapable of feeding the new cells; hence caseation results.

Chronic endarteritis—Atheroma—Endarteritis deformans

Causes.—Atheroma is constantly present in advanced life, especially in those who have followed laborious occupations, or who have suffered severely from syphilis, gout, or the effects of chronic alcoholism. Strain plays the most important part in the causation, as is evidenced by the following facts:—(1) The disease occurs during the later years of life, especially in persons whose occupation has entailed considerable strain on the circulatory system; (2) it chiefly affects the large arteries, and the parts of these bearing the greatest strain of the circulation, *e.g.* the origins of large branches; (3) the pulmonary and smaller vessels usually escape or are but slightly affected; (4) women are less affected than men, and the young are practically immune.

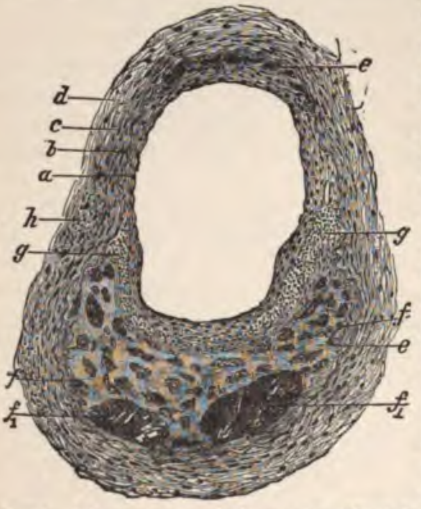

FIG. 8.—Atheromatous cerebral artery × 50 (Ziegler). *a*, intima considerably thickened; *b*, bounding elastic lamella of intima; *c*, media; *d*, adventitia; *e*, necrotic denucleated tissue with masses of fatty detritus; *f* and f_1, detritus with cholesterine plates; *g*, infiltrated leucocytes in the intima; *h*, infiltrated leucocytes in the adventitia.

Morbid anatomy and effects.—The disease begins in the deeper layers of the intima, which are infiltrated by proliferation of the cells and escaped leucocytes. The change occurs in patches varying in size up to that of a shilling, but by coalescence of these, larger tracts are formed. The patches, which are smooth on the surface from persistence of the endothelium, are at first of a gray colour, but become yellowish when degeneration has set in; they project into the lumen as slightly raised, flattened areas. The cellular exudation, being devoid of vessels, undergoes fatty degeneration and caseation; lime salts are deposited, and more or less extensive calcareous plates result, which subsequently come in contact with the blood stream, owing to destruction and separation of the endothelial lining (*laminar calcification*). In other cases the caseated area liquefies (*atheromatous "abscess"*), the material, when microscopically examined, being found to consist of fatty débris, stearic acid, and cholesterine crystals. The softened area bursts into the blood current, leaving what has been called an atheromatous "ulcer"; the vessel wall is consequently weakened, but very rarely ruptures, except in the case of the cerebral arteries. The change, although originating in the inner coat, is not confined to it, the inflammatory process gradually extending to the muscular and outer tunics. The muscular fibres are destroyed and replaced by new cellular exudation, so that the vessel loses its elasticity and contractile power, and no longer recoiling during diastole, becomes permanently dilated. The changes in the outer coat lead to periarterial thickening, so that the weakened condition of the vessel is to some extent counteracted; if this compensation be insufficient to resist the force of the blood stream, the weakened vessel will dilate and form an aneurismal sac. It sometimes happens that the weakened inner and middle coats yield and the blood finds its way down between the muscular layers (*dissecting aneurism*), but more usually this is prevented by the matting together of the coats by chronic inflammation.

In the smaller vessels thrombosis may occur in consequence of the blood coming in contact with the rough and irregular calcareous plates, and embolism may result from disintegration of the thrombus. Atheromatous arteries may be narrowed in consequence of contraction of the new tissue poured out in the adventitia and surrounding cellular tissue; the lumen is further encroached upon by the projection into it of the diseased patches, but these changes are never so marked nor are they so constant as in syphilitic endarteritis (p. 20).

Atheromatous vessels are rigid, inelastic, and tortuous; and their strength and power of resisting the blood pressure are materially diminished. The actual disease, in addition to the loss of support which this entails, renders these vessels specially unfit for the application of a ligature, and predisposes to the occurrence of secondary hæmorrhage.

CHAPTER II

DISEASES OF THE BLOOD-VESSELS—*Continued*

ANEURISM

AN aneurism is usually defined as being a "tumour containing blood communicating with the calibre of an artery." The term "aneurism" used alone refers to the fusiform or sacculated varieties, others being distinguished by a qualifying prefix.

Causes.—Arteries, like the other tubes and the hollow viscera in the body, will dilate, provided the walls are unable to withstand the pressure exercised on them by their contents. This inability may be due (1) to diminished resistance of the wall in consequence of disease; (2) to increased pressure of the contents; or (3) to a combination of these two conditions. By far the commonest cause of the disproportion between pressure and resistance is atheromatous disease of the vessel wall, the formation of an aneurism being frequently determined by some sudden—though perhaps slight—additional strain. As stated on p. 21, atheroma is dependent upon long-continued strain, syphilis, gout, and alcoholic poisoning, and these conditions are therefore indirect causes of aneurism. Syphilis and gout play, at the most, a very subsidiary part in its causation; chronic alcoholism is, however, of greater importance, probably by causing increased force of the heart-beat in addition to disease of the arteries. Strain not only induces atheroma and thereby lays the foundation of aneurism, but also, being continued, determines the occurrence of the dilatation.

It is, therefore, not surprising to find that those vessels and those parts of vessels which are most subjected to strain, and which, from their surroundings, are less able to resist it, are most often the seat of aneurism, *e.g.* the aortic arch, the popliteal and the cerebral arteries. Women are comparatively exempt from aneurism, and it is very rare under the age of thirty-five. Those following laborious occupations are, other things being equal, most liable to disease of the vessels and consequent aneurism; but mere hard work of a continuous nature is not so great a cause of aneurism as was formerly supposed, it being rather in cases of sudden and unaccustomed exertion that the vessel yields. Soldiers in times of peace cannot be considered to follow a laborious occupation, but the strain and privations of a campaign throw great additional pressure on the vessels and may lead to their dilatation. In other ranks of life, especially in England, men during their periods of relaxation often indulge in amusements, *e.g.* hunting, shooting, mountaineering, etc., well calculated to overstrain their arterial coats, and thus to lay the foundation of future aneurism.

An artery which has lost the support of the surrounding structures in consequence of suppuration may dilate, especially if the force of the blood stream be increased; this is well seen in the case of the pulmonary vessels traversing phthisical cavities, fatal hæmoptysis being due, in a large proportion of cases, to rupture of a small aneurism. Injury of the coats of an artery may lead to its immediate rupture and the formation of a traumatic aneurism (see chap. v. p. 58, vol. ii.), or may so weaken it that it subsequently dilates under the normal blood pressure. No doubt the formation of spontaneous aneurism is due in some cases to slight traumatism, sufficient to rupture the inner and perhaps the middle coats of a diseased artery, but insufficient to materially damage a healthy one.

Aneurism occasionally occurs on the proximal side of a ligature in consequence of the increased strain on the wall, which is itself probably diseased; should the vessel have been accidentally damaged during the application of the ligature, it is the more likely to dilate. The impaction of a simple embolus is said to be capable of inducing aneurism of the smaller vessels, but this is doubtful, and certainly very rare. An infective embolus may, however, weaken the coats by inducing inflammation, and may thus lead to acute aneurism. In rare cases, apparently healthy arteries are very prone to dilate under the blood pressure; many such aneurisms may occur in the same patient, who is said to suffer from aneurismal diathesis; it is probable that in these cases infective emboli are responsible for the weakening of the wall.

Varieties and anatomy of aneurism.—The term aneurism has been applied to conditions varying in causation and anatomy, and requiring different methods of treatment. Some of these are so widely divergent that they will be separately described.

True and false.—A true aneurism is one in which all the coats of the vessel are present in the sac; if any coat be absent the aneurism is said to be false. These terms are of no practical importance. Nearly all aneurisms, except small fusiform ones, are sooner or later of the false variety.

Consecutive.—An aneurism is said to be consecutive when the blood is limited by condensed surrounding structures only, the coats of the vessel having undergone gradual atrophy from pressure. A diffused consecutive aneurism is one which has ruptured, the blood infiltrating the surrounding structures; this is not uncommonly seen in large thoracic aneurisms which have perforated the chest wall and given way beneath the skin.

Spontaneous and traumatic.—A spontaneous aneurism is dependent upon pre-existing disease of the vessel wall and not directly traceable to injury of the coats. Traumatic aneurism is dependent upon direct injury of the wall of the vessel, which may or may not be healthy. The distinction between spontaneous and traumatic is of great importance as regards prognosis and treatment. Most aneurisms are spontaneous, and the unqualified term always applies to this form.

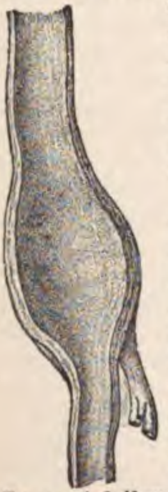

FIG. 9.—A fusiform aneurism of the common femoral artery (Bowlby).

Fusiform aneurism—aneurismal dilatation.—When the whole circumference of an artery is dilated for a limited portion of its length, the condition is spoken of as a "fusiform" aneurism. In most cases the vessel is the seat of extensive atheroma, and all the coats are present in the wall of the dilatation; but if the latter be very large the middle coat atrophies and disappears. The wall is increased in thickness by new tissue, and is supported by condensation of the periarterial structures. It usually happens that one part of the wall, weaker than the rest, dilates and forms a sacculus, which rapidly increases in size, and not uncommonly ruptures (Fig. 10).

A fusiform aneurism usually grows slowly, may attain a large size, and prove fatal by pressure; rupture is not common unless a sacculus is present. Spontaneous cure does not occur, and little or no coagulum is present in the sac. Fusiform aneurism is chiefly met with in the aorta, especially the ascending portion;

and if situated close to the heart may, by separating the valves, lead to aortic regurgitation.

Sometimes a considerable extent of an artery is dilated without the formation of any enlargement which can properly be called an aneurism; this is known as aneurismal dilatation, and is met with in the larger arteries, the basilar, and in the vessels composing a cirsoid aneurism (p. 3).

Sacculated aneurism is the most common form (Fig. 11, p. 29). One part of the circumference of an artery, weaker than the rest, dilates under the blood pressure, and a small pouch or sacculus results. At first this may contain all the coats of the artery in its wall, but as it increases in size the middle and inner coats atrophy and disappear, being only found quite at the mouth of the sac. The integrity of the latter is, therefore, dependent upon the external coat. The arterial coat is not merely stretched, since it is thicker than normal, instead of being thinned proportionally to the size of the sac, as mere stretching would occasion. This thickening is due to organisation of chronic inflammatory products; a similar condition of the periarterial connective tissue, which is blended with the sac wall, serves to afford it a certain amount of support, and thereby hinders the growth of the aneurism. In many cases the outer coat, which forms the true sac wall, is absorbed at the points of greatest pressure, and the blood or contained clot thus comes into direct contact with the surrounding structures (consecutive aneurism). Should this support prove insufficient to withstand the force of the blood pressure, the aneurism ruptures. The mouth of a sacculated aneurism is rounded or oval in form, and does not increase proportionately to the size of the sac. Sacculated aneurism may attain an enormous size and produce injurious effects through pressure.

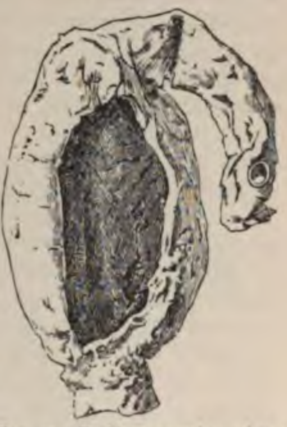

FIG. 10.—Fusiform aneurism of the thoracic aorta; part of the wall has been removed. The sac contained but little clot and had ruptured (Westminster Hospital Museum, No. 676. Drawn by C. H. Freeman).

The contents of the sac will be subsequently referred to.

Dissecting aneurism.—Fatty or atheromatous changes in the intima, especially if the middle coat be also affected, may result in transverse rupture under the pressure of the blood stream. The blood may then find its way down the wall of the vessel, separating the layers of the middle coat. This does not, however, necessarily occur, for the coats may be so matted together by plastic lymph that the blood cannot separate them; if this be the case, the wall at the seat of rupture, being a weak spot, will tend to dilate, and a sacculated aneurism will result. A dissecting aneurism may extend for a long distance; the blood, eventually reaching another weakened patch, ruptures it and re-enters the main stream. In other cases it may coagulate *in situ*, or may gradually distend the outer coat and cause death by rupture. Dissecting aneurism is confined to the aorta, and may extend as far as the iliacs.

Cirsoid aneurism—Aneurism by anastomosis (Fig. 1, p. 4).—This condition is improperly termed aneurism, and should be more fittingly classed with angeiomata (p. 3).

Aneurisms of traumatic origin.—Circumscribed traumatic aneurism, diffuse traumatic aneurism, and arterio-venous aneurism have been already described under Injuries of Vessels (see chap. v. vol. ii.).

Of the varieties of aneurism above mentioned the fusiform, sacculated, consecutive, circumscribed traumatic, and arterio-venous are the only ones to which the name can properly be applied. In all these there are certain points of close similarity, and the prognosis, clinical signs, and treatment are much alike.

Contents of the aneurismal sac.—An aneurism usually contains more or less clot; the amount will depend partly on the age of the tumour, and partly on whether it is fusiform or sacculated, and in the latter case on the size of the mouth relatively to the dimensions of the sac. In fusiform aneurism the whole of the blood stream passes through the sac. Being but little delayed, there is hardly any deposition of fibrin, a few shreds being the most met with. In the sacculated variety, only a part of the blood finds its way into the aneurism, and its velocity being slowed, laminæ of clot are deposited on the roughened interior. As will presently be seen, coagulation of the blood is a conservative process tending to diminish the growth of the tumour, to prevent its rupture, and, under favourable circumstances, to bring about spontaneous cure.

If an aneurism containing clot be laid open, the coagulum will be found to be of two different kinds, passing, however, insensibly into one another without any hard-and-fast line of separation. Externally, *i.e.* nearest the wall, is the active clot of Broca. It is distinctly laminated, the laminæ not extending completely round the sac but overlapping one another (Fig. 11). The lamination becomes less distinct as the centre of the sac is reached. The active clot is pale, decolorised, and firm—these characters being best marked in the external, *i.e.* the oldest layers. When the aneurism has existed for a long time, the clot may undergo fatty degeneration, and present here and there patches of softening. The active clot is so called because it is deposited from actively flowing blood; it also takes an active part in retarding the increase in size of the sac and in promoting spontaneous cure.

The inner clot is called "passive," and is simply recent coagulum, which is formed in the same way as the active clot (and has as much right to be so called), but which has not attained a sufficient age to show lamination. Such lamination does not necessarily prove that the fibrin was gradually deposited from flowing blood; nor does its absence prove the reverse, for we know that the outer layers of clot in a traumatic hæmatoma may, after a time, be distinctly laminated. The passive clot is darker coloured and softer than is the active.

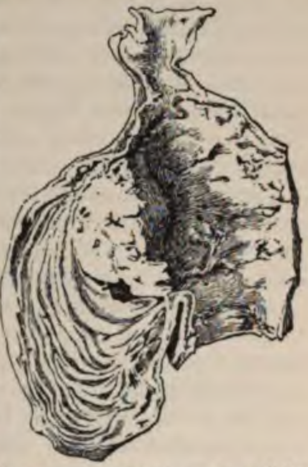

FIG. 11.—Sacculated aneurism of the first part of the aorta which has undergone spontaneous cure. The outer part of the clot is laminated (active clot), the inner is homogeneous (passive clot). (Westminster Hospital Museum, No. 704. Drawn by C. H. Freeman.)

The amount of clot in the different parts of the sac is by no means necessarily uniform. Those parts of the sac containing only a small quantity are the least supported, and hence will increase in size more rapidly than the rest, and be more likely to rupture. Secondary pouches and sacculi may be completely obliterated.

As already stated, the presence of clot is beneficial to the patient, it not only acts as a buffer to the blood stream, but it also, by partly filling the sac, limits the amount of blood passing through it, and hence the distending force is proportionately diminished. Portions of the clot may become detached, and so induce embolism, the effects of which will depend on circumstances; in rare cases a large embolus may occlude the distal end of the vessel and lead to spontaneous cure (see p. 34).

The pressure effects of aneurism.—An aneurism, being a tumour, will induce certain pressure effects, but does not produce any special local effects peculiar to itself. The following are the changes which the various tissues may undergo:—

Pressure on soft parts.—As already stated when speaking of the sac wall, the soft structures surrounding the sac undergo a very chronic process of inflammation leading to organisation. The new tissue thus formed tends to support the sac and blends with its proper coat; the sac wall, however, being compressed by the dense structures round it and by the blood-clot within, may in the course of time become absorbed, and the coagulum and blood will then be limited by condensed soft structures only (consecutive aneurism).

Pressure on bones leads to erosion of their substance. The appearance of bone eroded as the result of pressure differs materially from that due to destruction by caries. In the former case the destroyed area is perfectly regular, and is not usually surrounded by inflammatory osteophytes, nor does it show any traces of disease—the bone having simply been gradually absorbed. In caries the diseased surface is irregular and worm-eaten, the surrounding periosteum has given birth to new bone as the result of the irritation, and in recent specimens the carious cavities would be filled with unhealthy granulations. Flat bones, *e.g.* the sternum, may be perforated, the aneurismal sac bulging through the perforation and beneath the skin; eroded ribs may break and cause serious damage to, and probable rupture of, the sac wall.

It is in thoracic aneurisms that the effects of pressure on bones are best seen. The bodies of the vertebræ—many of which are often implicated—are smoothly eroded on their anterior aspects; the discs are eroded to a much less extent, and consequently the bone directly above and beneath them is protected, the erosion being deeper in the centre of the body, so that the eroded area is (-shaped. All the vertebræ subjected to pressure are affected in about the same degree. In rare cases the erosion is so extensive that the spinal canal is opened. In spite of the destruction there is no resulting deformity, as opposed to what is met with in spinal caries. This is due to the facts that the intervertebral discs are more or less intact, that the erosion, as a rule, does not extend very deeply, and that as the bone is removed its place is taken by the aneurismal sac, which, especially if containing dense clot, affords some support. The bone may replace the sac and be in direct contact with the clot.

If the bones entering into the formation of a joint become eroded and the ligaments softened and absorbed, disorganisation results.

Pressure on nerve trunks causes them to assume a riband-like appearance. The nerves embedded in the new fibrous tissue are often incorporated with the sac wall. Pressure on sensory nerves leads to severe radiating pain—so common and prominent a symptom of thoracic aneurism. When motor nerves are involved, paralysis results. This is well seen in the paralysis and atrophy of the laryngeal muscles from pressure on and stretching of the left recurrent laryngeal in aneurism of the aortic arch. Nerves which are subjected to long-continued pressure degenerate.

Pressure on vessels rarely leads to any serious results. Large venous trunks may become incorporated with the sac wall, and considerably diminished in calibre, or even entirely obliterated; œdema, venous congestion, and very rarely gangrene may result. It sometimes happens that the aneurismal sac presses on its own artery, and, limiting the flow of blood through it, favours the deposition of clot, and hence spontaneous cure (p. 35).

Special structures, such as the trachea and œsophagus, may be injuriously compressed by thoracic aneurisms. The effects induced will depend upon the degree of pressure and interference with the function of the part. Erosion and ultimate rupture of the sac into the tube compressed may follow.

Signs and symptoms.—The signs of an aneurism, when situated in such a position that it can be readily examined, are, under ordinary circumstances, unmistakable; but in many internal aneurisms the diagnosis is by no means so easy. Symptoms which are dependent upon their anatomical position will be mentioned under special aneurisms; in this place the symptoms will be considered only in the abstract.

The tumour, which is usually round or oval, is situated in the course of an artery of considerable size; it is irregular if the sac has yielded at one part more than another. At first the swelling is more or less compressible, the degree of compressibility being inversely proportional to the amount of clot in the sac.

Expansile pulsation is in the majority of cases easily felt, and is diagnostic. The pulsatile force depends on (1) the nearness of the aneurism to the heart; (2) the strength of the cardiac systole; (3) the depth of the aneurism from the surface; and (4) on the amount of clot in the sac. If there is a large amount of clot in the sac, pulsation may be very indistinct, and its expansile nature difficult of detection. Expansile pulsation is increased by elevation of the limb, and also by compression of the vessels below the aneurism. It is completely arrested, and the size of the tumour may be slightly diminished, by compression of the vessel on the cardiac side of the sac; but as soon as the blood is again allowed to enter the sac pulsation returns, though not reaching its former force until a few beats of the heart have quite filled the sac with blood. If spontaneous cure has occurred, pulsation is necessarily absent, and it is much diminished or absent if the sac has ruptured.

Bruit.—If a stethoscope be applied over the tumour, a distinct bruit—rough, rasping, or blowing in character—is heard. It is systolic in time, but is occasionally double. The bruit is not so distinct if the mouth of the sac is large in proportion to the size of the tumour, or if the aneurism is deeply seated, contains much clot, or has ruptured. The loudness of the bruit is dependent on the same conditions as is the force of the expansile pulsation. A thrill may often be felt.

The pulse below the aneurism, as compared with that of the corresponding vessel on the opposite side, will be found to be diminished in volume and force, and to be somewhat delayed in time.

Pressure symptoms.—An aneurism, like any other tumour, gives rise to signs in addition to those diagnostic of its nature, dependent on the pressure it exercises on surrounding parts. The chief of these is pain, which may, especially in thoracic aneurisms, be very severe, and is of a radiating nature. Pain may be entirely absent. Congestion and œdema may result from pressure on veins. Special pressure symptoms are met with according to the neighbouring anatomical relations of any given aneurism (see p. 49).

Diagnosis.—The diagnosis of aneurism when the tumour is readily accessible is usually quite easy. In some cases, however, this is by no means the case. If spontaneous cure has occurred, pulsation may be absent and the surgeon must chiefly rely on the history of the case. If the sac has ruptured and the aneurism has become diffused, the symptoms are modified, the pulsation or bruit being either absent or very faint (see p. 33).

Solid or cystic tumours pressing on an artery may have pulsation communicated to them by the vessel, but this *is never expansile;* such tumours are usually unaccompanied by a bruit, but if a sound is present it is not of the same rasping nature as that in an aneurism, being rather a dull thud. These tumours are not compressible, whereas aneurism is usually so to some extent; moreover, non-aneurismal tumours may, unless bound down to the arterial sheath, be moved aside from the vessel when all communicated pulsation ceases.

Simple abscess, accompanied as it is by redness, swelling, heat, throbbing pain, and constitutional disturbances, is in the majority of cases—even if pulsation (never expansile) be communicated to it—readily distinguished from aneurism. It must, however, be remembered that inflammation and suppuration of the aneurismal sac and the soft structures round it may occur, and all the signs of acute abscess be present; the history of the case and the presence of expansile pulsation will aid in the diagnosis (see p. 35).

Soft pulsatile tumours of bone, usually sarcomatous or cancerous in nature, may closely simulate aneurism, but in such the pulsation is less forcible and the expansibility but slight; there may be a bruit, but it is usually absent or only very faint. A pulsatile tumour is often compressible, as it largely consists of vascular trunks. The history of the case, the obvious connection of the tumour with a bone, its situation away from the course of the main artery, and perhaps the gradual failure in health, and the presence of secondary deposits may assist the diagnosis, which is sometimes very difficult.

Progress and termination of aneurism.—In the majority of instances an aneurism, unless it be cured by treatment, gradually increases in size and ultimately proves fatal by pressure on some vital part or by rupture of the sac. In the small minority of cases spontaneous cure results, and the successful treatment of aneurism is largely based upon an accurate knowledge of the process by which Nature may effect such cure, the surgeon adopting means calculated to imitate as nearly as possible that process.

Rupture of the sac.—When the sac wall is no longer able to withstand the force of the circulation it will give way at the weakest spot; rupture may also be due to injury. The effects of rupture vary according to circumstances. In most cases of internal aneurism it is immediately fatal, but if the sac is so situated that the free escape of blood is limited by the surrounding structures, a fatal issue may be prevented. If an aneurism presses on a mucous surface this becomes gradually thinned, and at one spot a very minute hole is formed, through which drops of blood escape (*weeping aneurism*). The aperture gradually increases in size and the amount of hæmorrhage becomes proportionately greater; at length the aperture suddenly enlarges and fatal hæmorrhage occurs. This condition is well seen in the case of a thoracic aneurism bursting into the trachea; the patient coughs up a few small coagula during the day; these increase in size and number; and lastly, the sac empties itself through the air-tube. In the case of pressure on the œsophagus the "weeping" stage is not seen, and the first indication of rupture is profuse hæmorrhage and instant death. When an aneurism ruptures into a serous cavity the opening is a ragged rent, an inch or more in length.

If an aneurism is so situated, *e.g.* the popliteal, that rupture does not cause death owing to the limitation of the blood, certain signs will be present indicative of the serious accident which has happened. The patient experiences sudden and acute pain in the part, extending down the limb; the tumour increases rapidly in size and loses its previous outline; and the pulsation and bruit are much less evident or entirely absent. If the escape of blood is large the patient may become very pale and may even faint, and present all the signs of severe hæmorrhage. The swelling gradually increases and becomes harder; the skin is stretched and shiny, and may slough, the blood then escapes externally and death results. In less serious cases the pressure of the extravasated blood on the veins causes œdema, lividity, coldness, and cramp of the limb, and if the interference with the circulation be sufficiently grave gangrene will result. In rare cases the extravasation is small in amount, and the blood being at high tension, the artery is compressed by it, so that further bleeding is prevented.

Spontaneous cure of aneurism.—An aneurism may undergo spontaneous cure: (1) by the gradual obliteration of the sac by clot; (2) by inflammation and suppuration of the sac.

(1) **The gradual deposition of clot** may be brought about in various ways. The coagulum completely fills the sac, and theoretically should extend into the artery as far as the nearest branch on the proximal and distal sides of the sac.

(*a*) In all sacculated aneurisms there is a continual tendency to the formation of laminated clot, but although a considerable amount may be formed in the course of time, it is rarely sufficient to cause spontaneous cure (Fig. 11, p. 29). The conditions favouring such a deposition are practically those which cause slowing of the stream in the sac; quiet on the part of the patient, avoidance of anything likely to increase the force or frequency of the heart-beat, and narrowness of the mouth of the sac being the most important.

(*b*) Embolism. Accidental circumstances may determine cure in this manner; thus, a portion of fibrin may become detached from the wall of the sac and, lodging in the distal portion of the vessel, may cause sufficient obstruction to the flow of blood through it to partly divert the blood stream from the main trunk along the collateral paths. The result of this is to limit the amount of circulation through the sac, and consequently to favour coagulation and spontaneous cure. Fergusson sought to induce this process by manipulating the sac in the hope of detaching a portion of clot; and distal ligature, when it effects cure, does so by imitating this method.

(*c*) Another method by which accidental circumstances may lead to the formation of sufficient laminated clot to cause permanent cure is found in those rare cases in which the aneurismal sac limits its own blood supply by pressing upon the supplying artery. This process is imitated by the surgeon when he employs compression or ligature on the proximal side, and also by genu-flexion.[1]

When an aneurism undergoes spontaneous cure by the deposition of clot it will be found that the vessel on the distal side, between the sac and the origin of the next branch, is contracted, while on the proximal the nearest branches are dilated and collateral circulation established. By these means nature diminishes the flow of blood through the sac, and consequently its pressure on the sac wall, in addition to favouring coagulation.

When cure is in progress it will be noted that the pulsation becomes less and less evident and finally ceases; at the same time the tumour contracts, and becomes harder and more localised, pressure symptoms being proportionately relieved. In the course of time the aneurism is converted into a mass of dense fibrous tissue, and the vessel is usually obliterated as far as the nearest branch on the proximal and distal sides.

(2) **Inflammation and suppuration of the sac.**—When inflammation is excited in the cellular tissue surrounding the sac the process extends to it and to the vessel, in which thrombosis occurs. If the coagulum in the supplying vessel is strong enough to withstand the force of the blood stream, the resulting abscess of the sac (which may then be practically regarded as being outside the circulation) may burst and, the contents being evacuated, healing by granulation will occur. Much more commonly, however, suppuration leads to rupture and fatal hæmorrhage, the clot in the proximal end of the vessel not being strong enough to withstand the force of the blood stream, which, in view of the fever and consequent increased force of the heart-beat, is somewhat raised.

The inflammation begins in the soft structures surrounding the sac, gradually invades the wall and deprives it of its vascular supply. It is more likely to occur in cases of rapidly increasing aneurism in young subjects, and may be induced by frequent or rough manipulation. Occasionally suppuration follows ligature of the supplying artery, either within a few days of the operation, or at a more remote period. An aneurismal sac which has been cured may inflame and suppurate even after a long time.

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[1] Some surgeons describe the method of cure by the deposit of fibrin, by the impaction of an embolus, and the pressure of the sac on its artery as three distinct methods of cure. This seems hardly correct, since the process is the same in all, only the means inducing it differ.

Symptoms.—It is of the first importance to recognise the symptoms indicative of inflammation so that steps may be taken to avoid the ensuing dangers. The tumour rapidly increases in size and pulsation becomes more forcible; the overlying skin is red, hot, slightly tender, and œdematous, and later on may be glazed and shiny. Pain is considerable, and the temperature is raised two or three degrees with accompanying constitutional disturbance. If the inflammation does not subside the symptoms deepen and all the signs of suppuration are present. If left alone the abscess will burst, and this will usually be followed by profuse and fatal bleeding, or the bleeding may recur from time to time unless efficient means of treatment be adopted. When, as above stated, the vessel is thrombosed, and the buffer thus formed is capable of withstanding the force of the blood stream, permanent cure may result, the clot and contents of the sac being evacuated, and the cavity closing by granulation. Surgically the operation of Antyllus imitates spontaneous cure by suppuration.

Treatment.—If sloughing is threatened Hunter's operation, when possible, should at once be performed; ligature close to the sac is contra-indicated by the local inflammation.

In some cases, suppuration follows in spite of ligature of the main vessel, and unless great care be taken fatal hæmorrhage may ensue. Under these circumstances a tourniquet should be placed in the line of the vessel below the point of ligature, and an assistant should be in constant attendance to tighten it should bleeding occur; every effort must be made to subdue the inflammation and avert suppuration. If it appears probable that these means will be useless, or if suppuration has already occurred, the sac should be freely laid open and its contents evacuated under strict aseptic precautions.

If hæmorrhage does not occur it may be hoped that the vessel is blocked sufficiently firmly to withstand the force of the circulation, and the wound being dressed, careful watch should be kept by a skilled assistant so that the tourniquet (previously adjusted) may be utilised if the vessel bleeds. If at the time of operation, or subsequently, hæmorrhage should occur, an attempt must be made to secure the vessel *in situ*; but should this be impossible, or should the rotten condition of the coats have rendered them unfit for the application of a ligature, amputation is the appropriate treatment, for the application of a ligature higher up (the vessel being already occluded at a distance) would almost certainly lead to gangrene, which itself imperils life and demands amputation.

THE TREATMENT OF ANEURISM

General treatment.—But little prospect of complete permanent cure can be looked for by constitutional treatment, the most that we can anticipate being some amelioration of the symptoms and arrest of the increase in size of the sac; and, therefore, although general means must be adopted in all cases surgically treated, they must never be relied on for cure of cases in which surgery has at her command some simple, safe, and comparatively certain method.

The treatment, which must be carried out for a long time, aims at the reduction of the blood pressure, so that the sac may be able to withstand it and the coagulation of the blood in its interior be favoured.

Rest is the most important desideratum, and must be absolute. The patient should be confined to bed in the recumbent posture, and should not be permitted to perform any act for himself, being assisted to all he wants and remaining absolutely passive. Mental quietude and avoidance of all excitement is as necessary as physical rest.

Diet.—By gradually diminishing the amount of solid and fluid nourishment, in combination with complete rest, it is assumed that cure will be promoted: (1) by lessening the force of the circulation, (2) by increasing the coagulability of the blood. Tuffnell, who strongly advocated this plan of treatment, advised that the diet should be eventually limited to—bread and butter, 6 ozs., roast meat, 2 ozs., and milk, 6 ozs., in the twenty-four hours. Such a diet is, however, not to be given in the case of the aged or enfeebled, and in all cases it is very irksome and not so successful in practice as has been claimed by its advocates.

Drugs.—Narcotics and anodynes may be required for the relief of pain, but no drug has any curative influence. Iodide of potassium in full doses has been recommended, and is still largely employed, but it is probably quite useless. The drug is supposed to increase the coagulability of the blood, but is chiefly given in view of the frequency of syphilis as an etiological factor in inducing the arterial degeneration to which aneurism is due. Anti-syphilitic treatment, although doubtless of great value in the prevention of arterial disease, and hence of aneurism, is probably quite useless when aneurism has once formed; for it cannot repair the existing disease of the vessel wall, and may, on the other hand, promote absorption of inflammatory new tissue, and thereby weaken the sac which would, under such circumstances, increase more rapidly in size under the blood pressure.

Acetate of lead, iron, and ergotine have all been used. Ergotine is liable to do more harm than good, since by contracting the small arterioles it causes a rise in the general blood pressure; the drug cannot cause any contraction of the sac wall, since the muscular coat has undergone atrophy.

Surgical treatment.—The surgeon has at his command numerous means for the cure of aneurism, some of which are under ordinary circumstances comparatively simple, safe, and effective, while others are dangerous, and at the best palliative only. Whenever possible, proximal compression or ligature of the main vessel is the method to be adopted; the chief indications for the employment of any other will be given under the appropriate heading.

Treatment by ligature.—Ligature may be employed in one of the following ways:—

(1) Close to the sac on the proximal side (Anel's operation).

(2) At a distance from the sac on the proximal side, with the intervention of a branch or branches (Hunter's operation).

(3) On the distal side of the sac (Brasdor's operation).

(4) On the distal side with the intervention of a branch (Wardrop's operation).

(5) On the proximal and distal side close to the sac which is laid open or completely excised (Antyllus's operation).

Proximal ligature close to the sac—Anel's operation.—This operation is not usually performed in cases where it is possible to ligature the artery at a distance, as recommended by John Hunter. It has the comparative disadvantages of being more difficult and dangerous on account of the proximity of the sac; the operation is, however, at the present time more in favour and less dreaded by surgeons than formerly, owing to its greater safety under the antiseptic régime, the advantages claimed for it being that the circulation through the sac is more certainly controlled, and hence recurrent pulsation is less common and, moreover, the danger of gangrene is diminished as the artery is ligatured low down. It would appear that, in most cases at least, the vessel itself is quite as fit for ligature close to as it is far away from the sac, the real dangers of Anel's operation being: (1) that the proximity of the sac makes it difficult to secure the artery, not only by its presence, but because the normal relations of the parts are probably altered and the guides to the vessel lost; (2) that the sac may be damaged during the operation, and in consequence may become the seat of inflammation, suppuration, and secondary hæmorrhage.

Anel's operation would seem to be especially applicable to those cases in which compression has been attempted but has failed to cure, for in such it is well known that subsequent ligature by Hunter's method may prove equally unavailing on account of the too free collateral circulation; it may also be performed in cases of recurrent pulsation.

Proximal ligature at a distance from the sac — Hunter's operation.—When it is decided to effect cure by ligature, the vessel should, when possible, be secured at a distance from the sac, with the intervention of collateral branches between, so that some direct blood flow through the aneurism is permitted. The risk of secondary hæmorrhage is small; the danger of wounding the aneurism is avoided, and suppuration of the sac is much less likely to occur than it is after Anel's operation.

Method of cure.—Ligature at a distance limits but does not arrest the circulation through the sac, since the blood reaches it by collateral channels. The force of the blood stream is likewise diminished, and the strain on the sac wall and the soft structures supporting it being in great measure relieved, their natural elasticity is brought into play and causes some contraction of the tumour. This limitation of the force and volume of the blood current favours coagulation, which, coupled with the contraction of the aneurism, results in permanent cure.

Collateral circulation is as a rule established very quickly, and faint pulsation may be detected in the sac the day after the operation. No doubt in many cases of aneurism collateral circulation is to some extent established naturally in the course of the disease, in consequence of the slight hindrance to the circulation which the sac occasions, and if compression has been attempted before a ligature is applied, the collateral channels will be more or less dilated. In some cases the collateral circulation is inefficient or too great, and gangrene or recurrent pulsation may result after ligature of the main trunk.

When cure is complete the sac is filled with clot, which extends into the vessel as far as the next collateral branch above and below; the vessel is also occluded at the point of ligature, and consequently two chains of collateral circulation are necessary, one to carry blood from above the ligature to that part of the vessel intervening between it and the aneurismal sac, and a second to convey blood from the vessel above the sac to the trunk below. It sometimes happens (chiefly in those cases where the mouth of the sac is very small and the aneurism itself affects only a limited portion of the circumference of the artery and is more or less pedunculated) that cure occurs without obliteration of the main trunk above and below the sac; in such no second chain of collateral circulation will be necessary, but the danger of further dilatation of the artery with the formation of a so-called secondary aneurism is increased.

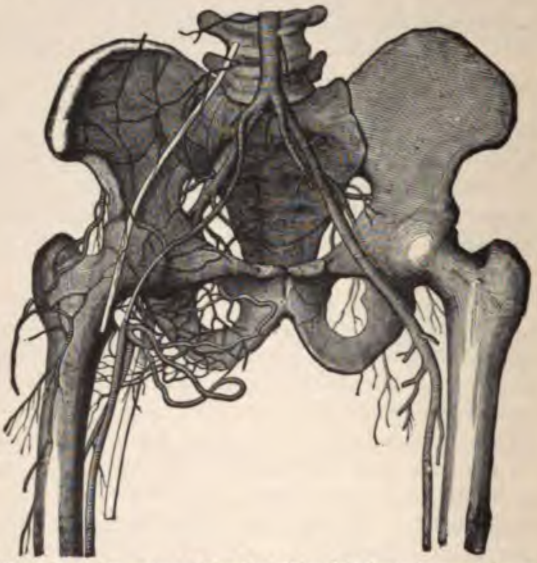

FIG. 12.—Collateral circulation after obliteration of the right femoral artery; from a specimen of Verneuil's in the Musée Dupuytren (Follin).

Clinical effects of ligature.—Immediately the ligature is tightened, the pulsation, bruit, and thrill cease in the sac, which becomes somewhat smaller, as it is no longer distended with blood.[1] On the following day faint pulsation may be detected in the sac, indicating the establishment of collateral circulation. This, however, gradually becomes less and less perceptible, and finally disappears, provided ligature is successful in effecting a cure. Pulsation in the distal vessels is at first feeble, but gradually grows stronger as the collateral channels dilate and convey more blood. The tumour becomes smaller, harder, more distinctly localised, and finally, is reduced to a small mass of dense fibrous tissue. The temperature of the limb is for the time slightly increased, but soon returns to the normal. This temporary increase is dependent on congestion from diminution of the *vis à tergo*, and partly perhaps on interference with the sympathetic nerves at the seat of ligature. After ligature of the main artery of a limb there is some loss of muscular power in consequence of the lessened blood supply, and for a similar reason numbness, cramps, and coldness may be complained of.

Dangers of ligature.—After ligature of the main artery the patient is open to the dangers detailed at p. 64; he is also liable to certain dangers dependent on the existence of the aneurism. Inflammation and suppuration of the sac is more likely to follow if the ligature has been placed close to the sac, and occurs more often in the upper than the lower limb.

Gangrene of the moist variety may occur after ligature. It most usually does so from the second day to the end of the first week. Its extent and rapidity of progress varies. Sometimes one or two toes (in the case of the leg) or a part of the foot becomes gangrenous; in other cases the gangrene spreads more or less rapidly up the leg. When a ligature has been applied gangrene may occur from the following causes:—

(1) Inefficient collateral circulation.

(2) Injury or inclusion of the vein in the ligature.

(3) Exposure of the limb to cold, especially if the heart is naturally weak.

(4) Compression of the vein by the sac. Gangrene from this

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[1] In rare cases it happens that, although ligature causes considerable diminution of the pulsation, it does not arrest it. This is due to the fact that an aberrant vessel, arising above the point of ligature, rejoins the main trunk before the sac is reached; hence blood is carried directly by it to the aneurism. If this is found to be the case, the abnormal vessel must be sought for and tied, but if its presence be not detected at the time of operation and is only suspected later, when recurrent pulsation is present, the treatment must be as described at p. 42.

cause may not ensue for some weeks after the operation, and is very rare.

A knowledge of the causes inducing gangrene will enable the surgeon to adopt such measures as will tend to ward off its occurrence. Thus great care must be taken that the vein remains uninjured; should injury unfortunately occur, it would be wiser to refrain from tying the artery for some time (p. 63). If there is evidence of venous obstruction from pressure of the sac, ligature should give place to compression if possible.

After ligature of the vessel the limb should be kept slightly elevated, and enveloped in a large mass of cotton-wool to protect it from cold, and if thought advisable hot bottles should be placed in the bed, but not too near the limb, too great heat being as injurious as cold. Every effort should be made to maintain the strength of the patient, and to encourage the action of the heart should this be feeble. Good and easily digestible food given frequently in small quantities, stimulants, digitalis, and ammonia if the heart is acting badly are the chief indications. If gangrene actually supervenes, the surgeon should wait until a line of demarcation manifests itself, and should then amputate as close to the seat of ligature as is considered necessary and safe. By waiting he may succeed in saving the greater part of the limb, for in cases where the gangrene is limited to a few toes or part of the foot, amputation may be safely performed just above.

Failure of ligature—Recurrent pulsation.—As already seen, faint pulsation (disappearing as cure proceeds) may be detected in the sac a few hours after the application of a ligature, but such pulsation may recur to an abnormal extent, and, by persisting, may necessitate some additional means of treatment.

Under such circumstances, when the aneurism is examined the day after the operation, pulsation may be found to be as forcible, or nearly as forcible, as before. This may be dependent on (1) slipping of an imperfectly knotted ligature; (2) the presence of an aberrant vessel; or (3) too free collateral circulation. The last may be the result of previous compression which has failed to cure the aneurism.

Pulsation sometimes recurs some weeks or months after the operation, and is apparently dependent on the absorption or disintegration of an imperfectly formed clot.

It by no means follows that the return of pulsation is incompatible with ultimate cure without further surgical treatment, for such pulsation may gradually diminish, especially if the general means already detailed be put in force (see p. 37). Should this treatment fail or appear hopeless from the first, digital compression of the artery above, or direct pressure on the sac, may succeed.

Failing this, and the general circulation in the limb being good, the too free collateral circulation may be diminished by placing a ligature below the first. Thus in the case of popliteal aneurism, where the femoral has been deligated at the apex of Scarpa's triangle, a ligature may be placed on the femoral in Hunter's canal, or on the popliteal just above the sac, with a view to controlling the circulation. It must not be forgotten, however, that the application of a second ligature is a serious proceeding, and may be followed by gangrene. The alternatives are the old operation of Antyllus with excision of the sac, or amputation.

The operation of Antyllus, always a difficult and hazardous procedure, is less so in cases of recurrent pulsation; for in such partial cure has taken place; the sac is therefore smaller and more localised than it was before, and hence the vessel can be more easily secured. Amputation remains for those cases in which the above means fail or appear inappropriate.

Distal ligature—Brasdor and Wardrop's operations.—In thoracic and some carotid aneurisms proximal ligature is impossible; under such circumstances a ligature may be applied to vessels on the distal side, provided the conditions of the case warrant this procedure. Brasdor's operation consists in placing a ligature on the distal portion of the artery without any intervening branch; Wardrop ligatured the vessel, leaving a branch between the site of ligature and the aneurism; in this method also more than one artery is often tied, *e.g.* subclavian and carotid, either at the same time or consecutively.

The object aimed at in distal ligature is the encouragement of coagulation by slowing and diverting the blood current, so that less blood passes through the sac but circulates through collateral channels; thus, supposing a case of innominate aneurism treated by ligature of the carotid and subclavian, the blood passes mainly through the vessels of the opposite side. It may happen that when there is no vessel between the sac and the ligature, the clot formed at the seat of ligature extends backwards into the sac, and, gradually increasing in size, tends to fill it; but there is no actual proof that this occurs. Considerable success has attended distal ligature, but the cases must be carefully selected; in the majority perhaps we cannot hope for more than amelioration of the symptoms, although several cases of cure have now been reported.

Immediately after the application of the ligature the pulsation in the sac will be increased, but it gradually diminishes as the blood stream is diverted and coagulation occurs. It may happen that distal ligature fails entirely, and indeed does more harm than good by causing a rise of pressure in the sac, which consequently increases in size and finally ruptures.

Proximal and distal ligature—Antyllus operation—Excision of the sac.—The operation of Antyllus may be necessary (1) for an aneurism so situated that proximal ligature alone either cannot be done, or is very dangerous or productive of bad results, *e.g.* gluteal aneurism; (2) for traumatic aneurism; (3) for rupture or suppuration of the sac; and (4) in some cases of recurrent pulsation when milder means fail.

The operation has already been described in speaking of varicose aneurism (see chap. v. vol. ii.).

When it is proposed to remove the sac, it is carefully isolated and freed from important structures, the vessel is ligatured above and below, and the tumour dissected away.

This is a difficult and hazardous procedure, and is fraught with many dangers, chief among which may be mentioned profuse hæmorrhage, inclusion in the ligature of adjacent nerve trunks or of the vein, gangrene, secondary hæmorrhage, or inflammation and suppuration extending to the neighbouring tissues and exposing the patient to the risk of septic or infective processes.

Treatment by compression.—Instrumental or digital compression of the artery supplying an aneurismal sac leads, as does ligature, to clotting, accompanied by contraction of the sac and surrounding tissues. Compression cures by inducing coagulation of the blood in successive stages, the coagula being represented in the cured aneurism by flattened-out laminæ. When the sac and the supplying artery are full of coagulum, all pulsation ceases, but the ultimate cure depends upon the gradual organisation of the clot. Recurrent pulsation may occur if the clot disintegrates instead of organising.

Compression has this advantage over ligature, that it does not obliterate the artery at the part compressed. It requires, however, much more supervision, and entails, in fact, constant watching. Ligature is more certain in its results. Compression can only be carried out in arteries superficially placed and so situated that pulsation can be arrested by moderate and localised pressure. It is especially applicable to aneurism of the lower limb. Cure is more likely to follow in quiet, phlegmatic patients who are not much inconvenienced by a treatment which is at best distinctly irksome.

Preparation of the patient.—For some days before treatment is commenced the patient should be kept in bed on a moderate, non-stimulating diet. The bowels should be attended to, and absolute rest and quiet enjoined. The area to be compressed must be shaved, thoroughly cleansed, well powdered, and protected by a pad of lint, so that irritation is reduced to a minimum and local inflammation avoided.

The bed must be comfortable, neither too soft nor too hard, and the limb, being wrapped in cotton-wool (access being allowed to the seat of the aneurism), should be semi-flexed and comfortably supported by pillows. During the treatment opiates may be necessary to allay pain and quiet the patient.

Instrumental compression.—Suitable tourniquets are applied, it being borne in mind that the object is not to constrict the whole limb but to limit pressure to the artery, otherwise the collateral vessels will be obstructed. All possible care should be taken that the important venous and nervous trunks are not compressed, otherwise considerable pain, perhaps rendering the continuance of the pressure impossible, may be occasioned. Two instruments should be applied at different parts of the artery, but not too far apart, and when pressure at one point causes annoyance to the patient, the other tourniquet may be tightened, and then the first relaxed, and so on. Pressure should be continuous, but if the tourniquet cannot be tolerated it may be relaxed, and a weight applied over the vessel, or digital compression substituted.

The circulation may be completely or partially arrested according to the tightness of the tourniquet. In the former case cure is more rapid; but the clot is softer, not so stable, and more likely to disintegrate. Complete pressure, moreover, occasions considerable pain, and frequently necessitates the use of morphia or complete anæsthesia. Cure may be complete by this method in five hours, but digital compression should be continued for some hours longer.

If the circulation be only partly arrested, cure takes a much longer time—often some days; but the clot formed is much denser, and is adherent to the sac wall.

Instrumental compression is not in much favour.

Digital compression.—Digital compression has the great disadvantage of requiring a staff of assistants, and is therefore rarely used in private practice. Each assistant compresses with the thumbs, or index fingers, placed one on the top of the other, aided by a bag of shot (from five to seven pounds in weight) overlying them. Another assistant supervises the pulsation in the sac. The assistants must be changed every fifteen minutes, the oncoming assistant compressing the vessel at a point a little distance away from that selected by his predecessor, who may then remove his thumbs. The pressure must be graduated, so that it is just sufficient to arrest pulsation—severe pressure may cause ulceration. If the circulation be completely arrested, cure may result in from five to ten hours; but if it be only partially arrested, many days may be necessary. The treatment should, if the patient can tolerate it, be continuous; but if he becomes irritable or cannot sleep, it must be interrupted. Digital compression may be used in some cases (*e.g.* the carotid) where instrumental is impossible; and in all it is superior, since the hand can regulate the pressure and localise it to the vessel better than can an instrument, however carefully applied.

Reid's treatment by Esmarch's bandage.—This method, formerly used especially for the cure of popliteal aneurism, and now practically abandoned on account of its danger and uncertainty, consists in applying the elastic bandage to the limb from the foot up to the ham, then lightly over the tumour and again tightly up the thigh. By this means circulation is arrested, and the sac and artery in its immediate vicinity are filled with fluid blood, which coagulates and obliterates the sac and the artery on the proximal and distal sides for some distance. The bandage should not be left on more than about an hour; but digital compression should be afterwards kept up for four or five hours, or longer, to ensure the safety of the clot, which is very soft and easily broken down. During the treatment the limb must be wrapped in cotton wool, slightly raised and protected from cold, and the patient should be kept under an anæsthetic during the time the bandage is on; when this is removed, a hypodermic of morphia may be given. The great dangers which attend and have led to the abandonment of this method are:—rupture of the sac, gangrene, and interference with the heart's action from the increase of blood pressure due to exsanguinating the limb.

Flexion.—This is applicable to popliteal aneurism; it is uncertain as a means of cure, and causes such considerable pain and inconvenience that it is but rarely used. It produces cure by directly compressing the sac, and by bending the artery and hence narrowing its calibre, thereby favouring the slowing of the blood stream and coagulation.

Supposing the popliteal artery to be the seat of aneurism, which it is sought to cure by flexion, the foot and leg are firmly bandaged, and the leg is then flexed on the thigh and bandaged to it. The chief dangers are rupture of the sac or suppuration. Flexion may be advantageously employed in cases of recurrent pulsation.

Galvano-puncture.—Galvano-puncture is employed in thoracic aneurisms which are not amenable to any other form of treatment. A certain small number of complete cures have been reported by this means; but the most that we can usually hope for is temporary amelioration, for it quite commonly happens that that part of the sac which is not filled by clot, being exposed to the full force of the blood pressure, undergoes an increase in size with thinning of its wall, leading to ultimate rupture and death from hæmorrhage. The proceeding itself, if carefully carried out, would seem to be devoid of immediate risk. Suppuration along the needle tracks and consequent hæmorrhage need not be feared if fine, properly insulated needles be used.

Embolism is shown to be rather a theoretical than practical danger. The object of galvano-puncture is to produce coagulation of the blood, and thus to obliterate the sac or partly fill it, thereby encouraging the formation of additional coagulum. It is necessary to employ a fairly strong, constant current; an ordinary Leclanché battery of ten to twenty cells being generally used.

The needles must be carefully insulated, the best material for this purpose being vulcanite. The positive needle should be made of gold or platinum in order to resist the corroding action of the acids liberated. It is better to insert both poles, as the action is quicker, more certain, and less painful; but some surgeons prefer to insert the positive pole only, others again change the poles during the sitting. The cure may be completed at one sitting, or if circumstances arise necessitating the temporary abandonment of the process, another attempt may be made in a few days. The clot formed at the positive pole is firmer and smaller in amount than that at the negative; its reaction is acid. The clot at the negative pole is frothy, soft, and unstable, hence the suggestion of changing the poles during the operation. There is also a considerable amount of tar-like blood intermingled. The frothy character of the negative clot is due to the liberation of hydrogen. If the sac is completely filled and pulsation arrested (often an impossibility), it will be found that pulsation will shortly return, owing to absorption by the tissues of the hydrogen contained in the clot; such pulsation will, however, in successful cases, disappear as fresh clot is deposited from the circulating blood.

The duration of a sitting must be determined by the effect produced on the aneurism and on the patient, who does not require an anæsthetic; prolongation to two hours need not be feared, provided his condition admits of it.

Acupuncture—Macewen's operation.—Acupuncture may be adopted in aneurisms which are unsuitable for treatment by ligation or compression, and in which the sac can be easily got at. Heath records a case of cure by this means. He had amputated at the shoulder with a view to curing a case of traumatic aneurism of the subclavian, but this treatment failed; he succeeded by introducing "three pairs of sewing needles into the tumour, making each pair cross within the sac; they were not withdrawn until the fifth day, by which time considerable clotting had taken place." Unfortunately the patient died from bronchitis on the seventeenth day, but the autopsy proved that the cure was complete.

Macewen advises (and has successfully practised his method in thoracic and other aneurisms) that fine needles should be introduced into the sac, and the opposite wall systematically scratched so as to slightly injure it. According to Macewen, this leads to the formation of a "white clot" composed of fibrin and broken-up leucocytes. Both these procedures are hazardous, and should be reserved for cases in which less dangerous and uncertain methods cannot be adopted.

The introduction of foreign bodies within the sac—Moore's treatment.—The introduction of horse-hair, catgut, or preferably fine iron wire into the sac of an aneurism in order to promote coagulation has met with but little success, and owing to its dangers is almost abandoned. Iron wire wound on a reel is the best material, and may be introduced through a Southey's canula. A few feet should be used, and if a good result is obtained the process may be repeated. In many cases this operation has caused sloughing and rupture of the sac. It is only to be considered in the treatment of aneurisms so situated that nothing else can be done, and in which galvano-puncture has failed to produce any good effect.

Treatment by coagulating injections.—The use of coagulants is practically abandoned, the danger of embolism and suppuration being great. Wooldridge's fibrin ferment is recommended as probably the best coagulating agent; iron may also be used.

This treatment should never be employed unless the proximal and distal portions of the vessel can be compressed during and for some time after the injection, and in cases in which this is possible the surgeon has other quite simple means of cure at his disposal.

Amputation in cases of aneurism.—Amputation may be required under any of the following circumstances:—

(1) Suppuration of the sac.
(2) Rupture of the sac (p. 36).
(3) Secondary hæmorrhage after ligature.
(4) Gangrene from venous obstruction, or after ligature.
(5) In some cases of axillary or subclavian aneurism (p. 54).

ANEURISM OF SPECIAL ARTERIES

ANEURISM OF THE THORACIC AORTA

Aneurism of the thoracic aorta is usually situated in some part of the arch, especially the ascending portion. The fusiform variety is common, but sooner or later the wall, yielding most at the weakest part, becomes sacculated and may rupture (Fig. 10, p. 27).

Signs.—The signs of thoracic aneurism are: (1) those due to its character as an aneurism; (2) those which are produced by its pressure on surrounding parts; these being such as would appear in the case of any tumour, whether aneurismal or not, with similar anatomical relations.

A thoracic aneurism, if of small size or so placed that no special pressure effects are produced, may run its course without detection; rupture being the first and last indication of its presence. In other cases the tumour attains a very large size, erodes the chest wall, projects beneath the skin, and may become diffused in the cellular tissue or rupture externally.

Physical examination of the chest usually reveals an area of dulness, visible pulsation distinct from the cardiac impulse, and a bruit of varying character; yet all these signs may be absent. There may be a difference between the pulses of opposite sides, those vessels implicated by the aneurism pulsating less strongly and a little later in time than the others. The larger arteries may even be obliterated and only receive their blood by collateral channels.

The pressure signs depend for their character upon the situation of the tumour, for their severity upon its size. The thoracic veins may be obstructed or obliterated, and in rare cases form an artificial communication with the interior of the aneurismal sac. Venous obstruction may be indicated by dilatation of the veins, and sometimes by œdema, but such signs are rarely present, since the veins are very capacious.

Pressure on nerves causes lancinating neuralgic pain in the chest and down the arms, with a sense of weight and oppression in the thorax. If the left recurrent laryngeal nerve be stretched over the sac, there may be spasmodic attacks of dyspnœa; when the pressure has existed for some time the nerve undergoes degeneration, and the muscles of the larynx are consequently paresed and finally paralysed; the crico-arytenoideus posticus especially suffers, so that there is loss of the power of abduction of the left cord. The voice may be more or less lost through the muscular paralysis; it may also be rendered metallic and brassy from direct pressure on the trachea.

Pressure on the trachea causes dyspnœa, and if the larynx be held and the patient then told to swallow, the "tracheal tug" is experienced. If the aneurism erodes the trachea it may, before final rupture occurs, "weep" into the tube, the patient coughing up clots of blood, which gradually increase in size and number (see p. 33).

Pressure on the œsophagus causes dysphagia, and all patients presenting themselves with this symptom should be carefully certain amount of clot may be produced at one part of the sac, but the wall is liable to dilate elsewhere, often more rapidly than before, and finally ruptures; moreover, these operations are in themselves not free from danger, and should only be attempted in carefully selected cases, preference being given to galvano-puncture or Macewen's acupuncture. Distal ligature of the carotid and subclavian vessels has met with a certain measure of success, but it may merely hasten the end by causing increased pressure in the sac. It should only be performed in selected cases, and on fairly strong patients.

ANEURISM OF THE ABDOMINAL AORTA

Aneurism of the abdominal aorta is very rare, and almost confined to the male sex. The neighbourhood of the cœliac axis is the usual situation of the sac, but it is liable to occur at the origin of any of the large vessels, which may themselves be implicated.

Signs.—The patient complains of a sense of weight and discomfort in the epigastric region, which he often attributes to dyspepsia. There is epigastric pulsation, and an expansile tumour may be felt, especially if an anæsthetic be given. Pressure symptoms are not very marked, but as the vertebræ are eroded, there will be constant gnawing pain which may radiate along the course of the lumbar nerves. If the sac presses upon the vena cava, there may be venous dilatation and œdema.

Treatment.—Beyond rest and ordinary treatment little can be done. If the aneurism is low down, instrumental compression by means of Carte's compressor under anæsthesia may be attempted. This should not be kept up longer than two hours, but may be repeated if good results; the treatment is certainly dangerous. Acupuncture or the introduction of wire into the sac has not given encouraging results.

ANEURISM OF THE INNOMINATE ARTERY

The innominate may be alone aneurismal, or the sac may implicate the aorta; the fusiform and sacculated varieties are both met with. The tumour tends to grow upwards, forwards, and outwards, bulging forwards the clavicle and upper ribs, rendering prominent the lower part of the sterno-mastoid muscle, and causing pressure on the brachial plexus, the right recurrent laryngeal nerve, the trachea, and œsophagus. It thus produces effects similar to those described under Thoracic Aneurism (p. 49). The circulation through the carotid and subclavian arteries is diminished, the pulsation being slight, feeble, and delayed as compared with that on the other side. If the venous circulation is impeded, there will be congestion, and perhaps œdema of the arm, neck, and upper part of the chest.

Pressure on the sympathetic causes contraction of the pupil, with vascular engorgement and sweating of the right side of the face and neck.

Treatment.—Complete rest and general treatment should be given a fair trial. If the patient is in good health and the circumstances generally considered seem favourable, the carotid and subclavian vessels may be simultaneously ligatured; but if such a procedure is negatived, acupuncture, electrolysis, or the introduction of wire into the sac may be tried in the order given.

ANEURISM OF THE COMMON CAROTID ARTERY

Aneurism of the common carotid usually occurs on the right side; it is not infrequently met with in women and during early life.

The sac, which does not usually attain a large size, is most often met with near the bifurcation or low down, and in the latter case may implicate the innominate.

Pressure symptoms arise from involvement of the larynx, trachea, œsophagus, and recurrent laryngeal or sympathetic nerves. The expansile character of the pulsation is diagnostic of aneurism, distinguishing it from other tumours seated near the vessel and receiving communicated pulsation from it. Pulsatile bronchocele may closely simulate aneurism, but a little care should render the distinction easy.

Treatment.—If the sac is near the bifurcation, digital compression against the transverse process of the sixth vertical vertebra may be attempted, or proximal ligature of the vessel should be performed. When the sac is low down, distal ligature is the only resource.

Electrolysis or acupuncture may occasion cerebral embolism.

ANEURISM OF THE EXTERNAL OR INTERNAL CAROTID ARTERIES

Aneurism of these vessels is very rare; the sac may implicate the upper part of the common trunk. The **treatment** consists in digital compression or ligature of the common carotid.

INTRACRANIAL ANEURISMS

On account of the natural thinness of their walls and their liability to syphilitic disease, fusiform or sacculated aneurism of the intracranial vessels is common.

The basilar and middle meningeal arteries are most often affected, but aneurism is by no means limited to them. Intracranial aneurism may produce no definite symptoms until it ends fatally by rupture. Sometimes there are evidences of pressure on or softening of the brain, and in rare cases a bruit may be heard through the skull.

In suspected cases rest and general treatment is all that can be done; ligature of the internal carotid or vertebral arteries might be performed if the situation of the sac could be definitely determined.

INTRAORBITAL ANEURISM

The sac may be in connection with the ophthalmic artery, or may extend forwards from the internal carotid trunk. Traumatic aneurism sometimes occurs; the onset in such cases is sudden, and may be accurately determined by the patient, who experiences a peculiar sound or snap.

Aneurism of the orbit occasions some degree of proptosis, swelling, and perhaps œdema of the lids, orbital pain extending up the forehead, conjunctival swelling and congestion, and buzzing or whirling noises in the head. Pulsation may be very distinct, and a bruit may be heard if a stethoscope is applied to the anterior temporal region.

Treatment.—If rest and general treatment prove of no avail, an attempt may be made to bring about cure by compression of the common carotid, or by ligature of the internal.

ANEURISM OF THE SUBCLAVIAN ARTERY

Aneurism of the subclavian usually affects the third part; the intrathoracic portion of the left subclavian is, so far as known, never the seat of aneurism. The right artery, on account of the more free and frequent use of the right arm, is more liable to become aneurismal than is the left. The tumour pushes forwards the clavicle, projects up into the supra-clavicular triangle, or extends towards the axilla. There is weakness of the arm, with limitation of movement which is accompanied by pain. The pressure effects are mainly due to implication of the brachial plexus and subclavial vein. The radial pulse on the affected side is feeble and delayed in time as compared with the other.

Treatment.—The treatment of subclavian aneurism is very unsatisfactory in its results and dangerous in practice. A fair trial should be given to complete rest and general treatment, combined with moderate direct elastic pressure with sponges over the sac, care being taken that such pressure is not sufficient to excite inflammation or cause rupture. Should this fail, galvano-puncture or acupuncture may be tried.

Proximal ligature is very dangerous, but should be resorted to if the above means prove useless. Distal ligature alone is useless, but, combined with amputation at the shoulder joint, may be adopted in cases where proximal ligature is contra-indicated or fails to cure.

ANEURISM OF THE AXILLARY ARTERY

The right vessel is more usually affected than the left, and the second or third parts rather than the first. If the sac implicates the first part of the artery, the third part of the subclavian is generally affected; the tumour grows upwards and forwards, pushing the clavicular head of the pectoralis major and the clavicle before it, and exerting pressure on the vein and brachial plexus.

Aneurism of the second or third parts usually enlarges rapidly, and ruptures early owing to the very slight support to the sac. Pressure on the veins may cause coldness, lividity, and great œdema, or even gangrene of the arm. If suppuration occurs, care must be taken not to mistake the case for one of simple axillary abscess.

Treatment.—The arm being gently drawn to the side so as to afford some support to the sac, digital compression of the third part of the subclavian may be carried out, provided the position and extent of the sac permits.

Failing this, the subclavian must be ligatured in its second or third parts; the operation is not only difficult and dangerous, but may be impossible if the sac extends up under the clavicle. Under such circumstances, the surgeon may choose between galvano-puncture, acupuncture, and amputation of the shoulder or forequarter, according to the special circumstances of the case.

Syme practised the operation of Antyllus for the cure of axillary aneurism; this operation may be performed (1) if the aneurism is inflamed; (2) if the sac is very thin; or (3) if pulsation recurs after temporary cure by other means. The operation is very difficult, and care must be taken that no branch of the brachial plexus is included in the ligatures.

ANEURISM OF THE BRACHIAL, RADIAL, OR ULNAR ARTERIES

Spontaneous aneurism of these vessels is very rare. Traumatic aneurism sometimes occurs, and may complicate fracture or a punctured wound. In former days, when bleeding was commonly practised by barbers and ignorant persons, arterio-venous aneurism at the bend of the elbow was no uncommon result (see chap. v. p. 61, vol. ii.).

The signs of aneurism of any of these vessels are quite obvious, and the diagnosis presents no difficulty.

Treatment.—Digital or instrumental compression may be first tried, the alternative being proximal ligature by Hunter's method, or complete excision of the sac. If the aneurism is below the elbow, compression may be accomplished by flexion at the joint. Aneurisms of these vessels are very suitable to radical treatment by excision.

ANEURISM OF THE EXTERNAL ILIAC OR COMMON FEMORAL ARTERIES—INGUINAL ANEURISM

Inguinal aneurism is rare, and tends to grow upwards or downwards, according to whether it originates above or below Poupart's ligament; in some cases the sac extends in both directions, the part beneath the ligament being narrow. If the sac grows towards the abdomen its rate of increase is more rapid than would be the case if it grew towards Scarpa's triangle, since the support given to the tumour in the abdominal cavity is practically *nil.* The diagnosis is made by noting that the pulsation is of an expansile character. Pressure symptoms are not marked; movement at the hip is limited and painful.

Treatment.—If the sac chiefly implicates the external iliac artery, an attempt may be made to bring about consolidation by instrumental compression of the lower part of the aorta, or the upper part of the artery or common iliac may be ligatured. Aneurism of the upper part of the external iliac may be treated by aortic compression, ligature of the common iliac or acupuncture, according to circumstances.

Aneurism of the common femoral is best treated by ligature of the external iliac artery.

ANEURISM OF THE GLUTEAL OR SCIATIC ARTERIES

The gluteal artery is more often affected by aneurism than is the sciatic, and both are rare. Pulsation may be very indistinct, and its expansile character impossible of detection on account of the thick layer of muscle and fat overlying the sac. There is pain about the hip, with limitation of movement. There may be sciatica from involvement of the great sciatic nerve; the early appearance and severity of this symptom suggests sciatic rather than gluteal aneurism.

The diagnosis is sometimes very difficult, and has to be made from gluteal abscess and pulsatile tumours of the ilium.

Treatment.—The operation of Antyllus, with excision of the sac if possible, is especially applicable to these cases, and is the best treatment. Ligature of the internal iliac is a dangerous operation, and the collateral circulation is so free that it is not likely to be curative. In default of Antyllus's operation, the surgeon may attempt to bring about cure by rest and general measures; by galvano-puncture, or by acupuncture.

ANEURISM OF THE SUPERFICIAL OR DEEP FEMORAL ARTERIES

Aneurism of these vessels is rare. The diagnosis of the nature of the tumour presents no difficulty. The sac increases rapidly from want of external support, and may suppurate.

Treatment.—Compression of the common femoral may be adopted if the sac be sufficiently low. Proximal ligature of the common femoral or external iliac may be performed according to circumstances.

ANEURISM OF THE POPLITEAL ARTERY

The popliteal is the most common seat of aneurism calling for surgical treatment, and occurs next in frequency to that of the thoracic aorta. The frequency of aneurism in this situation is due to the proximity of the artery to the knee-joint, to the numerous branches it gives off, causing strain upon the parent trunk, and to the want of support to the vessel. The affection may be bilateral. The sac may spring from the anterior or posterior part of the vessel wall; in the former case, it grows more slowly, but may erode the bones and open up the knee-joint; in the latter, the pressure effects upon the vein and nerves are more marked, the aneurism attains a larger size, grows more quickly, and is more likely to become diffused.

Signs.—The patient complains of pain and stiffness about the knee, with limitation of movement, which he may attribute to rheumatism. The joint is often held in the semi-flexed position. The pain may radiate along the popliteal nerves, and be neuralgic in character; if the bone be eroded, the pain is more constant and gnawing. When the sac presses upon and invades the knee-joint, it may excite slight synovitis and consequent effusion. Physical examination reveals the presence of a pulsatile, expansile tumour.

Treatment.—Reid's treatment by Esmarch's bandage and semi-flexion are now generally discarded on account of the danger, *inter alia*, of rupture of the sac.

Digital or instrumental compression of the common or superficial femoral may first be given a fair trial; failing this, ligature of the femoral in Scarpa's triangle or Hunter's canal, or of the upper part of the popliteal, should be practised. Should the sac rupture, Antyllus's operation, if possible with excision of the sac, or amputation must be resorted to.

ANEURISM OF THE TIBIAL ARTERIES

The tibial arteries are, with the exception of the traumatic variety, very rarely the seat of aneurism. The same remarks apply to such cases as to aneurism of the arteries of the forearm (see p. 55). The treatment consists in proximal ligature, or excision of the sac; genu-flexion is practically abandoned.

CHAPTER III

THE LIGATURE OF ARTERIES IN CONTINUITY

WHEN an artery has to be ligatured in its continuity, the operation is performed, if circumstances permit, at a spot where it is free from important relations, is readily accessible, and, if possible, at some distance from any branch. This spot is known as the "point of election." The anatomical positions of the main arteries of the body are indicated by certain lines; generally speaking, the incision to expose any vessel is made in the line of that vessel; but in some instances the surgical line is not identical with the anatomical.

Most surgeons have abandoned the method of double ligature with division of the vessel between as being not only unnecessary but dangerous. Those who have advocated this operation contend, *inter alia*, that when an artery is divided it is able to retract fully, and that longitudinal tension being thus relieved, complete physiological rest is obtained. This is, however, rather theoretically than practically true, and by due attention to the position of a limb after ligature of its main artery, without division, complete rest and relaxation may be obtained. If an artery has been double-ligatured and divided, the patient, should a ligature slip, is exposed to the risk of sudden and fatal hæmorrhage—an accident which has happened in the practice of the most skilful surgeons. Lastly, it may be pointed out that double ligature necessitates a larger wound, more extensive dissection, and greater damage to the surrounding structures; it is, therefore, quite impracticable in the case of certain vessels.

Choice of a ligature.—The chief substances in use for the ligature of arteries are Chinese twist and floss-silk, carbolised and chromic catgut, kangaroo-tendon, and ox-aorta. Sterilised silk is more generally used than any other form of ligature, and if properly prepared is perfectly efficient. Ballance and Edmunds, in their work on Ligature in Continuity, say: "A perfect ligature must be sufficiently strong not to break; inelastic, round, smooth, pliable, and easily tied into a knot; not too bulky; absorbable, and yet not too readily so; and lastly, capable of being rendered certainly aseptic."

Chromic gut lasts quite long enough for perfect occlusion, provided the wound be aseptic and protected from all sources of irritation; it resists absorption for two months or more. Carbolised silk lasts longer, and kangaroo tendon longest of all. I have lately used salicylic floss-silk for all cases of ligature of large arteries in their continuity, and have been perfectly satisfied with the results: the ligature is soft, lies flat, and is easily manipulated. The thickness of the ligature must be proportional to the size of the vessel and the force of the blood current, but it should not be greater than is absolutely necessary.

Fate of the ligature.—All ligatures are foreign bodies; but if they are aseptic, and the wound does not suppurate, no harm ensues from their presence.

A few hours after the application of a ligature it is encapsuled by lymph and leucocytes, plasma cells gradually permeate its meshes, and it ultimately undergoes absorption, the plasma cells developing into connective tissue and replacing the ligature. The more permeable a ligature, the more quickly does it become absorbed, since the cells can attack it from many points. Those which are not permeable last longer, since they are absorbed from the surface only.

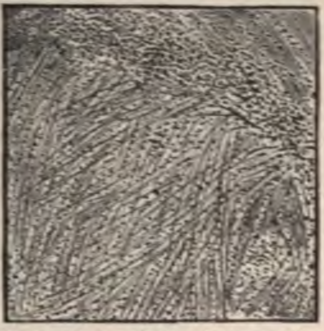

FIG. 13.—Section of a floss-silk ligature after use. The silk fibrils are moderately invaded by cells. The specimen shows the surface of the encircling loop (Ballance and Edmunds).

General conduct of the operation.—Each artery in the body is reached by careful dissection, which in many cases is easily divisible into certain stages, the object of each being to expose some definite anatomical landmark known as a "rallying point." During the early part of the operation the surgeon should, as far as possible, divest his mind of the idea that he is seeking for the artery, and should aim at the successive exposure and identification of each rallying point; for unless these be clearly made out, the operator may miss the vessel altogether, or inflict serious damage on other parts. As the dissection proceeds, all bleeding points should be at once dealt with, the wound being kept as dry and free from blood-clot as possible, otherwise identification of the various structures is rendered difficult.

The incision is usually, though not always, made parallel with the vessel and in its line. The length of the incision varies with the depth of the vessel from the surface, and with the importance of the structures in its neighbourhood; it should always be long enough to enable the surgeon to see clearly what he is about, so that he may avoid inflicting unnecessary damage. A short incision is bad surgery; there must be sufficient room for free manipulation. The skin being steadied by the left hand, the knife, held like a dinner knife, is entered at right angles to the surface, and the skin divided cleanly without any "tailing" of the ends. In the deeper dissection the parts should be divided to the same extent as the skin, or the wound will become funnel-shaped, and free manipulation be rendered impossible. The incision should, in all cases, be carefully made so that veins and cutaneous nerves are if possible avoided; should these be encountered, care must be taken not to wound them. They should where practicable be hooked aside, but in some cases the veins must be clamped, divided, and tied.

The dissection.—When the skin and subcutaneous tissues have been divided and the deep fascia is exposed, it must be slit up in the whole length of the wound, and the first rallying point sought for. When an intermuscular space has to be defined, a yellowish-white or blue line in the fascia may indicate its position; yet this guide is at best an uncertain one, for many such lines are often present. The most pronounced one should then be followed. The sense of touch frequently enables the surgeon to recognise the rallying point and any important structures he may come across, and is a most valuable aid in the operation—almost as much so as the sense of sight; its free use should never be neglected. When a muscular interspace has been found, it should be opened up by the handle of the knife, and may be advantageously enlarged by the index fingers. The wound must now be kept open by an assistant with hooks, or with retractors if it be deep. Any nerves which may be exposed should, if in danger, be held aside. The various stages of the operation being carefully conducted, the sheath of the artery will be exposed.

Opening the sheath.—The sheath must be opened in the centre of the wound. It is picked up with a pair of good forceps, and, the blade of the knife being held flat against it, is opened to a sufficient extent to enable easy passage of the aneurism needle. This part of the operation requires great care and delicacy of manipulation. When the sheath has been properly opened, the almost white coat of the artery will appear, a distinct "gutter" separating it from the sheath. The vessel is now carefully cleaned, first on one side then on the other. This may be done with a director, but the knife, in skilled and careful hands, is usually preferable. While cleaning the vessel the sheath should be securely held with forceps, and the knife, held like a pen, must be kept at right angles to the long axis of the artery, its edge being turned away from it, and the point never lost sight of. When one side is fully cleaned the other should be similarly treated. The last stage of cleaning the artery may be accomplished with the aneurism needle.

Passing the needle.—An aneurism needle should be well rounded at the point and highly polished to allow of its easily slipping round the vessel. In most cases it is passed unthreaded, but in deeply placed vessels which are difficult of access it should be previously threaded, the end of the thread being caught by forceps after the needle has been passed. The needle is always passed from the side on which lies the most important structure. Great care is necessary, and no force is allowable, or the point may be driven through the vessel, especially if its wall be diseased.

The sheath is held on the side from which the needle is passed, and when the instrument is half round—the point being kept in close contact with the vessel—the sheath is picked up on the opposite side and there held. Any difficulty experienced in passing the needle is a proof that the artery has not been properly cleaned. If, when the point of the needle projects on the opposite side, it be found to have carried before it any loose cellular tissue, this should be scratched through with the finger-nail, or cut through with the point of the scalpel. The ligature having been passed through the eye of the needle, the latter should be cautiously withdrawn, care being taken that the artery is not lifted from its bed. The surgeon should now satisfy himself that he has not included in the ligature any structure except the artery. Before tying the knot, the vessel should be compressed against the ligature as it is held tight, while an assistant ascertains that pulsation is arrested below; by this plan all doubt as to the identity of the artery is removed.

The knot.—The reef-knot is that employed by most surgeons. Ballance and Edmunds recommend a knot which they have called the stay-knot. This is practically a multiple reef-knot. They claim for it that each thread gives support to the other, that it thereby lessens the risk of slipping, and that the use of plural threads brings a greater extent of the intima into contact, and thus ensures permanent occlusion. Two or more threads can be passed round an artery as easily as one. "The best way of tying two ligatures is to make on each separately, and in the same way, the first hitch of a reef-knot, and to tighten each separately, so that the loop lies in contact with the vessel without constricting it; then, taking the two ends on one side together in one hand, and the two ends on the other side in the other hand, to constrict the vessel sufficiently to occlude it, and finally to complete the reef-knot. The simplest method of completing the knot is to treat the two ends in each hand as a single thread, and to tie as if completing a single thread" (Ballance and Edmunds). Whatever theoretical advantages may be claimed for any other form of ligature, it is found in actual practice that the single reef-knot is perfectly efficient. In tightening the ligature, sufficient force must be used to occlude the vessel. No doubt in most cases the middle and inner coats are ruptured, but the authors quoted contend that such rupture is not only unnecessary, but unadvisable and dangerous, since it inflicts damage on the arterial wall. They, moreover, maintain that perfect occlusion occurs if the lumen of the vessel is obliterated without rupture of any coat, provided the ligature used is not absorbed too quickly. Most surgeons will agree that it is wiser not to rupture any coat.

Completion of the operation.—The ligature having been cut short, the wound should be thoroughly dried and cleansed, the displaced parts replaced, and the wound closed with sutures. No drainage is necessary. Strict asepsis must, of course, be observed, and the dressing being properly adjusted the limb must be wrapped in wadding and kept slightly elevated in the position best calculated to relax the vessel and obtain perfect rest.

After-treatment.—This consists in giving sufficient rest to ensure complete occlusion of the vessel. The time required depends upon the size and importance of the artery, those of the lower limb and head and neck requiring more rest than those of the same size in the upper limb. Unless circumstances otherwise indicate, the dressings should not be touched until the end of the first week, when all sutures may be removed.

Accidents which may occur during the operation of ligature.—Certain accidents may occur, and difficulties arise during the performance of the operation, familiarity with which is of the first importance in order that they may be avoided or treated should they unfortunately be encountered.

(1) **Failure to find the vessel.**—Unless care be taken that the

incision is made in the correct situation, that each rallying point is clearly identified, and that the right intermuscular space is opened, the surgeon may fail to find the vessel. Abnormality of the main trunk may lead to a like result. Should this occur, the operation should be abandoned, for much damage may result from futile attempts to find the artery, and, moreover, the wrong one may be ligatured. Under these circumstances the vessel must be sought for at another point.

(2) **Identification of the artery** presents no difficulty if due care be taken. It must be remembered that pulsation may be conveyed to veins, nerves, and other structures. Nerve cords are, unless blood-stained, quite white; they can be felt as rounded cords which, unlike the artery, are incompressible. Veins may be distinguished by their colour, the thinness and the ready compressibility of their walls, and by the fact that they fill from the distal side. If, when the ligature has been passed, there is any doubt about its being round the artery, it should be gently pulled on while the finger rests upon the vessel; the tension on the ligature will then arrest pulsation below.

(3) **Damage to the artery** or a neighbouring branch. If the main trunk be wounded during the operation, a ligature must be placed above and below the seat of injury, and the artery be divided between. If a branch is wounded, it must be tied. In cases where a large branch is given off close to the seat of ligature, it should likewise be tied.

(4) **Damage to veins.**—The larger arteries are accompanied by a single vein; in most, but not all cases, the needle is passed round the artery from the side on which lies the vein. The vessels below the knee and elbow have a vein on each side; these frequently communicate by numerous branches crossing the artery, and it is consequently difficult or impossible to separate them. Under such circumstances the veins may be safely included in the ligature. In the case of large vessels, if the vein be wounded, no further attempt should be made to tie the artery at that spot; it must be ligatured higher up. If the case admits of delay, this should be done after an interval of a few days, in order that the venous circulation may be fully re-established, and hence the risk of gangrene minimised. If the wound in the vein is small, it may be picked up with forceps and a lateral ligature applied, or the bleeding may be arrested by the elastic pressure of a sponge retained in position for some hours.

(5) **Injury to special structures** will be considered under ligature of the individual arteries.

Accidents following the operation.—Ligature of an artery may be followed by secondary hæmorrhage or gangrene, or may fail in its object and pulsation return. Special dangers attend the ligature of certain vessels and will be mentioned later on.

Secondary hæmorrhage has already been fully discussed in chap. v. p. 84, vol. ii. The chief causes leading to it after ligature in continuity are—

(1) The use of an improperly prepared ligature, or a septic condition of the wound accompanied by suppurative inflammation.

(2) Previous disease or injury of the vessel during the operation. In the large arteries the risk of second hæmorrhage is increased if the ligature has been tied with sufficient force to rupture the middle and inner coats and the vessel wall thereby weakened.

Gangrene of the moist variety may follow ligature, especially if the temperature of the limb has not been properly maintained by the use of cotton wadding and hot bottles. Injury and obliteration of the accompanying vein, or failure of collateral circulation, may also lead to gangrene. It is more likely to occur after ligature of the vessels in the lower than in the upper limb.

The treatment consists in amputation at the seat of ligature.

For further information on this subject see Gangrene, chap. v. vol. i.

Recurrent pulsation will be found fully discussed at p. 42; it suffices here merely to point out that this may be due to the slipping of an imperfectly tied ligature, or too free collateral anastomosis with, perhaps (as in high division of the brachial), the presence of an abnormal branch (p. 41, footnote).

It must be remembered that the term recurrent pulsation implies that the pulsation persists and is considerable (p. 41).

LIGATURE OF SPECIAL ARTERIES

LIGATURE OF THE INNOMINATE ARTERY

Surgical line.—From the centre of the junction between the gladiolus and manubrium to the upper border of the right sterno-clavicular articulation.

Surgical anatomy—**Anterior relations.**—The sterno-hyoid and sterno-thyroid muscles, the remains of the thymus gland, the right inferior thyroid, and right and left innominate veins.

Posterior relation.—The trachea.

External relations.—The right innominate vein, the vagus, pleura, and lung.

Internal relations.—The left carotid artery and the trachea on a posterior plane. The remains of the thymus gland.

Operation—Position.—As for the subclavian (p. 72).

First stage.—Make a 3-inch incision along the anterior edge of the right sterno-mastoid to the sterno-clavicular joint, and from this another outwards along the inner half of the clavicle. Raise the flap, dividing the origins of the sterno-mastoid. Removal of the inner end of the clavicle much facilitates the subsequent stages and should always be undertaken.

Second stage.—Divide the sterno-hyoid and sterno-thyroid muscles, having first ligatured the anterior jugular vein.

Third stage.—Feel for the common carotid and open its sheath low down; then trace the vessel down to the innominate, carefully using a director for this purpose.

Fourth stage.—Clean the artery with the director and needle, avoiding the structures on the outer side. Pass the needle from without inwards.

Fifth stage.—Dry, cleanse, and close the wound, suturing the muscles separately, and provide drainage at the posterior angle. Keep the upper limb fixed to the side.

Difficulties and dangers.—If the neck is short and thick it may be impossible to reach the vessel without removal of the inner end of the clavicle. Free bleeding may occur unless great care be taken to avoid or clamp veins. The innominate vein may be wounded if care be not taken in cleaning the artery on the outer side. The pleura may be opened if the needle is pushed too far backwards and downwards. Secondary hæmorrhage is a formidable and fatal danger. Pleurisy and pneumonia may occur.

Collateral circulation.—By the anastomosis between the upper intercostal arteries with the superior intercostal and branches of the axillary, and by the union of the internal mammary with the phrenic and deep epigastric arteries.

LIGATURE OF THE ARTERIES OF THE HEAD AND NECK

LIGATURE OF THE COMMON CAROTID ARTERY

Surgical line.—From the top of the sterno-clavicular articulation to a point midway between the angle of the jaw and the mastoid process, the neck being extended and the face turned towards the opposite shoulder. The artery terminates at the upper border of the thyroid cartilage, occasionally below or beyond this point.

Surgical anatomy—Anterior relations.—Superficial structures with the platysma, deep fascia, and sterno-mastoid muscle. Below it is crossed by the sterno-hyoid and sterno-thyroid muscles, the anterior jugular vein lying on them. At the level of the cricoid cartilage the omo-hyoid crosses the artery obliquely upwards and inwards. The descendens hypoglossi nerve lies on and parallel with the sheath. The sterno-mastoid artery and the superior and middle thyroid veins cross the vessel in its upper half, and the internal jugular vein and thyroid body overlap it.

Posterior relations.—Longus colli and rectus capitis anticus major muscles, on which lies the sympathetic nerve. The inferior thyroid artery and recurrent laryngeal nerve cross behind the vessel at the lower part.

Internal relations.—The pharynx, larynx, trachea, œsophagus, and thyroid body. The œsophagus is nearer the left than the right artery.

External relations.—The internal jugular vein lies in the greater part of its course close to the artery, overlapping it in front. At the lower part on the right side the vein diverges from the carotid, on the left it lies in front of it. The vagus lies between the vein and artery, and posterior to both.

Seat of ligature.—By preference the artery is ligatured opposite the cricoid cartilage, but sometimes lower down.

Operation at the seat of election—Position of patient.—Shoulders slightly raised, neck extended, and the face turned towards the opposite side.

First stage.—A 3-inch incision is made in the line of the artery, the centre being opposite the cricoid cartilage. Divide the skin, superficial fascia, platysma, and deep fascia; expose the anterior edge of the sterno-mastoid muscle, define it carefully, and hook it outwards.

Second stage.—Define the upper border of the omo-hyoid which is now exposed, and hook the muscle downwards and inwards, taking care not to wound the superior and middle thyroid veins. If the neck is now slightly flexed the rest of the operation will be facilitated.

Third stage.—If the descendens noni nerve be visible draw it outwards. The internal jugular vein will be recognised by its colour, ready compressibility, and by its filling and collapsing with the respiratory movements; it must be carefully protected from injury. The sheath of the artery must now be exposed well to the inner side.

Fourth stage.—Open the sheath at the inner side, carefully clean the artery and pass the threaded needle from without in, taking care that its point is kept close to the arterial wall so that all danger of including the vagus nerve may be avoided. The ligature is carefully tied.

Fifth stage.—Gently replace the structures which have been hooked aside, cleanse and dry the wound, close it without drainage, and dress it antiseptically. The patient's head must be kept fixed between sand-bags, with the neck slightly bent to relieve tension.

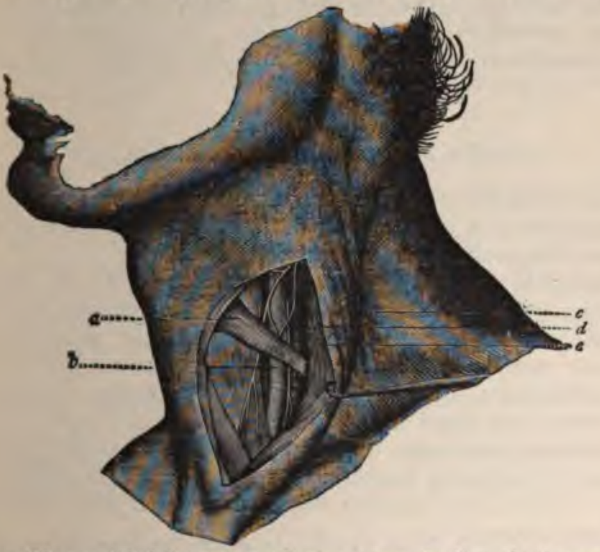

FIG. 14.—Ligature of the left common carotid artery. *a*, omo-hyoid muscle; *b*, artery *c*, internal jugular vein; *d*, vagus nerve; *e*, sterno-mastoid muscle (Follin).

Operation below the omo-hyoid.—The general steps are as above given, but the incision is made downwards from the level of the cricoid cartilage. The omo-hyoid, if exposed, is drawn upwards, the sterno-hyoid and sterno-thyroid muscles are drawn downwards and inwards, or if they are very broad, may be partially divided. Care must be taken that the internal jugular and inferior thyroid veins are not wounded.

Difficulties and dangers of ligature of the carotid.—

Distension of the veins, enlargement of the thyroid gland, or the presence of an aneurismal sac may cause considerable inconvenience. Ligature of the common carotid, especially if the ligature has been placed near the bifurcation, may be followed within a few hours or days by cerebral symptoms which may prove fatal or improve when collateral circulation is established. Syncope, twitchings of the limbs, cerebral softening, or cerebral embolism are the conditions which may be met with.

Collateral circulation is freely maintained by the vessels of the opposite side. The vertebral of the same side replaces the internal carotid in the circle of Willis. The anastomoses between the superior and inferior thyroids, and the profunda and princeps cervicis are also important.

LIGATURE OF THE EXTERNAL CAROTID ARTERY

Surgical line.—As for the common carotid (p. 65); the vessel extends from the upper border of the thyroid cartilage to a point opposite the neck of the lower jaw.

Surgical anatomy—Anterior relations.—At its origin the artery is covered by the superficial structures, platysma and sterno-mastoid muscles; it then passes beneath the stylo-hyoid and digastric muscles, and is crossed by the temporo-maxillary, facial, and lingual veins, and the hypoglossal nerve; finally, it sinks deeply into the parotid gland and is crossed by the facial nerve.

Posterior relations.—Separated from the internal carotid by the stylo-pharyngeus muscle and glosso-pharyngeal nerve. From below upwards, the superior laryngeal nerve, stylo-glossus muscle, and parotid gland.

Internal relations.—The hyoid bone, pharynx, lower jaw, and parotid gland.

Seat of ligature.—Below the digastric muscle between the origins of the superior thyroid and lingual branches.

Operation—Position of patient.—As for the common carotid (p. 66).

First stage.—A 3-inch incision with its centre opposite the great cornu of the hyoid bone is made in the line of the artery. Define the edge of the sterno-mastoid and hook it outwards, hook aside, or if necessary, clamp and divide the lingual and facial veins.

Second stage.—Define the lower border of the digastric muscle and hook it upwards with the hypoglossal nerve.

Third stage.—Clean the vessel opposite the hyoid bone and pass the needle from without inwards. If the lingual and the superior thyroid arteries are near the point of ligature they should both be secured.

Fourth stage.—Replace the structures, cleanse and close the wound without drainage.

Dangers in the operation.—The veins lying in front of the artery may be wounded, and unless the needle be kept close to its coats, the superior laryngeal nerve is liable to be included.

Collateral circulation.—By the vessels of the opposite side, and by communications between the facial and the ophthalmic branch of the internal carotid, and by the anastomoses between the profunda and princeps cervicis.

LIGATURE OF THE INTERNAL CAROTID ARTERY

Surgical line.—As for the external carotid (p. 68).

Surgical anatomy — Anterior relations.—Integuments, platysma, sterno-mastoid, digastric and stylo-hyoid muscles. The external carotid artery lies in front of the internal, the two being separated by the stylo-glossus and stylo-pharyngeus muscles, glosso-pharnygeal nerve and pharyngeal branch of the vagus. Parotid gland.

Posterior relations. — Rectus capitis anticus major muscle. Sympathetic and superior laryngeal nerves.

External relations.—Internal jugular vein and vagus nerve.

Internal relations.—Pharynx, tonsil, and ascending pharyngeal artery.

Operation.—First stage.—Make an incision as for ligature of the external carotid (p. 68), but a little farther back. Define the anterior border of the sterno-mastoid.

Second stage.—Draw the muscle backwards, and hook aside, or if necessary, divide the facial and lingual veins. Hook the hypoglossal nerve upwards and the external carotid forwards.

Third stage.—Clean the vessel and pass the needle from behind forwards, being careful of the internal jugular vein and vagus nerve.

Fourth stage.—Replace the separated structures, and close the wound without drainage.

Difficulties and dangers.—The internal jugular vein, vagus and hypoglossal nerves and external carotid artery are the structures to be specially avoided. Cerebral symptoms may ensue as after ligature of the common carotid (p. 68).

Collateral circulation.—By the vertebrals and anastomoses with the vessels of the other side in the circle of Willis.

LIGATURE OF THE LINGUAL ARTERY

Surgical line.—No definite line can be given, since the artery follows a tortuous course.

Surgical anatomy.—The lingual arises from the external carotid opposite the great cornu of the hyoid bone, and lies in a triangular space bounded by the sterno-mastoid behind, digastric above, and omo-hyoid below. The vessel ascends slightly, then forms a loop, and finally passes upwards and forwards to the tip of the tongue, and at the seat of operation is parallel with and above the hyoid bone. Superficial to it are the stylo-hyoid, digastric, and hyo-glossus muscles, the latter separating the artery from the hypoglossal nerve which crosses the artery at its commencement. Deep to the vessel are the middle constrictor and genio-hyo-glossus muscles; at the anterior margin of the hyo-glossus the artery bifurcates, the main branch or ranine running forwards on the under surface of the tongue. The veins are in close relation with the artery, but the ranine vein runs in company with the hypoglossal nerve.

Seat of ligature.—Usually beneath the hyo-glossus, but sometimes in the first part of the artery.

Operation beneath the hyo-glossus—Position of patient.—As for ligature of the carotid (p. 66), the chin being held upwards by an assistant.

First stage.—Make a curved incision, the centre of which is opposite the great cornu of the hyoid bone, from a point a little external to and below the symphysis of the jaw to a point opposite its angle, but not carried far enough to wound the external jugular vein, or deep enough to wound the facial artery. Divide the superficial structures and deep fascia, draw upwards the submaxillary gland and define the posterior tendon of the digastric.

Second stage.—Hook the digastric downwards, define the hypoglossal nerve in the upper part of the wound, and draw it with the ranine vein upwards. Now define the posterior margin of the hyo-glossus muscle. If the great cornu of the hyoid be kept in touch and the operation be conducted immediately above it, the artery is easily found.

Third stage.—Hook the hyo-glossus forward, or if necessary, partially divide it; feel for the vessel with the finger, and when defined, pass the needle from above downwards without any attempt to separate the veins.

Fourth stage.—Replace the structures, cleanse and close the wound without drainage.

Dangers during the operation.—If the mylo-hyoid muscle is very broad, it may possibly be mistaken for the hyo-glossus; it should be remembered that the hypoglossal nerve lies between the two. In dividing the hyo-glossus, care must be taken that the lingual artery is not damaged. If the dissection is carried too deeply, the middle constrictor may be wounded and the pharynx opened. Ligature of the lingual is a difficult operation; every stage must be carefully performed and the various landmarks made out.

Collateral circulation.—With the branches of the opposite side.

Ligature of the first part of the lingual may be accomplished by the same incision as for ligature of the external carotid (p. 68). The hypoglossal nerve is hooked upwards and the artery secured about three-quarters of an inch from its origin.

LIGATURE OF THE FACIAL ARTERY

This vessel may be easily secured where it lies on the jaw just in front of the masseter. A half-inch incision is made, the artery exposed, and the needle passed from behind forwards to avoid the vein.

LIGATURE OF THE TEMPORAL ARTERY

The temporal is reached by an incision one inch long just above the zygoma where the artery can be felt beating. Divide the deep fascia, define the artery, and pass the needle from behind forwards, *i.e.* away from the vein.

LIGATURE OF THE OCCIPITAL ARTERY

The first part may be tied through the same incision as for the external carotid (p. 68). The hypoglossal nerve must be hooked backwards and the needle passed from behind forwards.

The artery may also be reached at a distance from its origin through an oblique incision parallel with and slightly below the mastoid process. The hinder edge of the sterno-mastoid, the splenius and trachelo-mastoid muscles are successively divided as much as necessary and the artery is secured as it escapes beneath the digastric.

LIGATURE OF THE THIRD PART OF THE SUBCLAVIAN ARTERY

Surgical anatomy—Anterior relations.—The integument deep cervical fascia, clavicle, suprascapular artery, and subclavius muscle with its nerve. The external jugular, transverse cervical, and suprascapular veins cross the vessel and may form a large plexus in front of it. The subclavian vein is anterior to but on a lower level than the artery. Sometimes the transversalis colli artery crosses the subclavian, but is usually above it.

Posterior relations.—Scalenus medius and first rib. The lowest cord of the brachial plexus lies close to and slightly behind the vessel.

Superior relations.—The brachial plexus and omo-hyoid muscle.

Inferior relations.—The first rib and the subclavian vein.

Operation—Position of the patient.—The shoulders must be slightly raised, the neck extended, the face turned to the opposite shoulder, and the arm well drawn down to the side to depress the clavicle.

First stage.—Draw the skin down over the clavicle (to avoid wounding the external jugular vein) and make an incision three inches long, the centre of which is about an inch internal to the middle of the clavicle. Allow the skin to resume its normal position, when the wound will be about half an inch above the bone. Pick up and carefully divide the deep fascia, hook aside, or if necessary, divide the external jugular, transverse cervical, and suprascapular veins; should these form a large plexus, great care is necessary, as they are in the "dangerous area" (see p. 63, vol. ii.). If the omo-hyoid muscle is seen, hook it upwards.

Second stage.—Carefully define the posterior border of the scalenus anticus lying deep to and parallel with the sterno-mastoid. Trace the scalenus to the scalene tubercle on the first rib which should be felt with the palmar aspect of the index finger, draw the finger slightly upwards and outwards, and the artery will be felt and recognised by its compressibility. Above it the incompressible brachial plexus should be recognised.

Third stage.—Carefully open the sheath and clean the artery, never losing sight of the point of the knife. The threaded needle is passed from the plexus towards the vein, the point must be kept close to the artery and not pushed too far inwards, or the pleura may be wounded. In tying the ligature be careful that the first knot does not slip.

Fourth stage.—Cleanse and close the wound without drainage. The arm should be confined to the side and the patient kept in the recumbent position for at least a fortnight.

Difficulties and dangers.—The operation may be very difficult if the neck be short and thick, or if an aneurismal sac has pushed up the clavicle. The subclavian vein may lie high up in front of the artery, or may even change places with it; when this is the case, care must be taken not to wound it, or ligature it in place of the artery; in passing the needle the lower cord of the brachial plexus may be included, unless the point be kept close to the vessel.

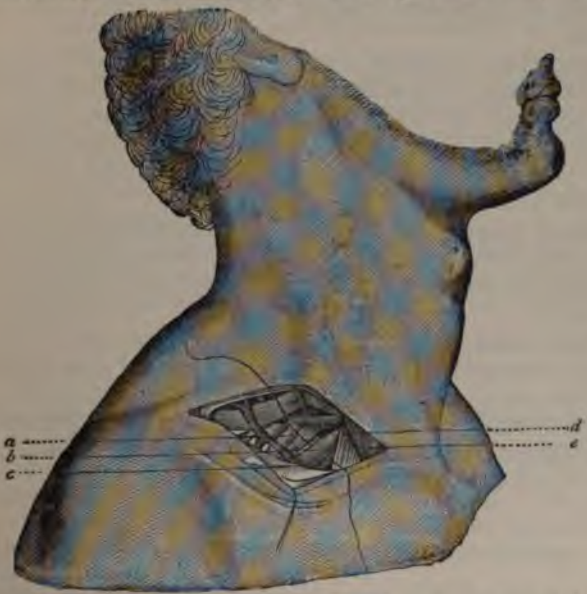

FIG. 15.—Ligature of the third part of the right subclavian artery. *a*, brachial plexus; *b*, artery; *c*, vein; *d*, scalenus anticus; *e*, sterno-mastoid (Follin).

Collateral circulation.—The suprascapular and posterior scapular arteries above anastomose with the subscapular and dorsal scapular below the point of ligature. The internal mammary with the long thoracic and subscapular arteries.

LIGATURE OF THE VERTEBRAL ARTERY

Surgical anatomy—Anterior relations.—Internal jugular and vertebral veins, inferior thyroid artery, and on the left side the thoracic duct. Sympathetic nerve.

Posterior relations.—Cervical nerves.

External relations.—Scalenus anticus muscle.

Internal relations.—Longus colli muscle.

Seat of ligature.—Before the vessel enters the vertebral foramina.

Operation—Position.—As for the carotid arteries (p. 66).

First stage.—Carefully make a 3-inch incision along the outer edge of the sterno-mastoid reaching downwards to the clavicle, and be careful not to wound the external jugular vein, which must be hooked forwards. Define the edge of the muscle and hook it forwards.

Second stage.—Using two pairs of dissecting forceps, carefully tear through the connective tissue and define the anterior edge of the scalenus anticus, avoiding the phrenic nerve which lies upon the muscle.

Third stage.—Feel for the transverse process of the sixth cervical vertebra and the artery will be found directly below it. Clean the artery and pass the needle from behind forwards.

Fourth stage.—Replace the structures, dry and close the wound.

Collateral circulation.—The vessel of the opposite side and others in the circle of Willis.

LIGATURE OF THE ARTERIES OF THE UPPER LIMB

LIGATURE OF THE FIRST PART OF THE AXILLARY ARTERY

Surgical line.—From the middle of the clavicle to the inner margin of the coraco-brachialis muscle, the arm being at right angles to the chest.

Surgical anatomy—Anterior relations.—The integument, clavicular head of the pectoralis major, the subclavius, and the costo-coracoid membrane. Cephalic vein, external anterior thoracic nerve, and acromio-thoracic artery and vein.

Posterior relations.—First intercostal space and first digitation of the serratus magnus muscle. Posterior thoracic nerve.

External relations.—Brachial plexus.

Internal relations.—Axillary vein.

Operation—Position.—Draw the patient to the edge of the table and let the arm hang over it, its middle resting against the edge so that the clavicle is well thrown up. The arm should be at right angles to the trunk.

First stage.—The best incision is from an inch external to the sterno-clavicular articulation to the coracoid process, curving downwards to the upper edge of the second rib.

Seek the interval between the clavicular and sternal heads of the pectoralis major, and isolate the former by means of the fingers passed beneath it; divide it from within outwards with a blunt-pointed curved bistoury.

Second stage.—Arrest all bleeding and define the upper border of the pectoralis minor, and draw it downwards and outwards.

Third stage.—Hook aside the acromio-thoracic artery and cephalic vein and open the costo-coracoid sheath. Feel for the vessel, open its sheath and pass the needle from above down, *i.e.* from the brachial plexus towards the vein.

Fourth stage.—Replace the structures and suture the divided muscles with chromic catgut. Clean, dry, and close the wound.

Collateral circulation.—See Subclavian Artery (p. 73).

LIGATURE OF THE THIRD PART OF THE AXILLARY ARTERY

Surgical line.—The arm being at right angles with the trunk a line from the middle of the clavicle to the centre of the elbow marks the position of the axillary and brachial arteries, the former ending at the lower border of the teres major muscle. The axillary is covered by a line passing through the axilla at the junction of the anterior and middle thirds of one drawn from the anterior to the posterior fold of the space.

Surgical anatomy—Anterior relations.—Pectoralis major in the upper half, skin and deep fascia below; the inner head of the median nerve crosses to the outer side.

Posterior relations.—From above down the tendons of the subscapularis, latissimus dorsi, and teres major muscles. The musculo-spiral and circumflex nerves.

External relations.—The coraco-brachialis muscle pierced at the upper part by the musculo-cutaneous nerve. Median nerve.

Internal relations.—The ulnar and internal cutaneous nerves and nerve of Wrisberg; the axillary vein.

Operation—Position of patient.—Arm at right angles with the chest and forearm supinated.

First stage.—Make a 3-inch incision along the inner edge of the coraco-brachialis, beginning well up in the axilla. The skin and deep fascia are divided, and the coraco-brachialis is defined and drawn outwards.

Second stage.—The median nerve is now found and hooked outwards. The internal cutaneous and ulnar nerves lie close to the vessel on the inner side, and may be hooked inwards if necessary; the vein lies more internal and may not be seen.

Third stage.—The artery is carefully cleaned and the needle passed from within outwards.

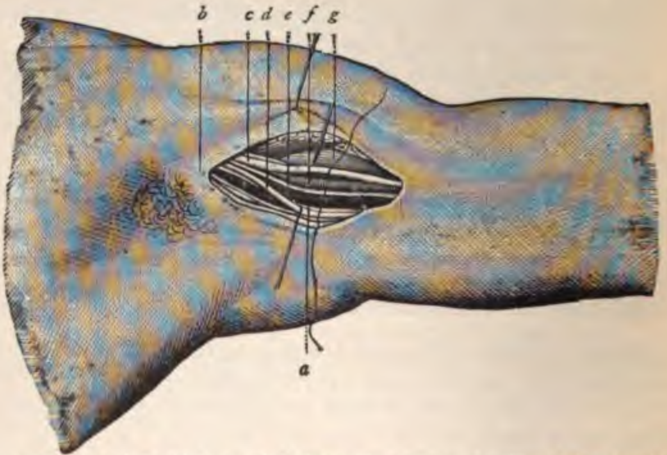

FIG. 16.—Ligature of the third part of the left axillary artery. *a*, axillary vein; *b*, axilla; *c*, median nerve; *d*, ulnar nerve; *e*, internal cutaneous nerve; *f*, axillary artery; *g*, coraco-brachialis muscle (Follin).

Fourth stage.—Replace the structures, cleanse and close the wound.

Collateral circulation.—If the ligature is placed above the subscapular artery the circulation is carried on by the suprascapular, posterior scapular, long thoracic, and intercostal arteries above, anastomosing with the branches of the subscapular below the point of ligature.

If the ligature is between the subscapular and circumflex arteries, the anastomoses are between the suprascapular and acromio-thoracic arteries with the posterior circumflex, and between the subscapular branches with the superior profunda.

When the ligature is below the circumflex, the branches of the circumflex and subscapular arteries anastomose with the ascending branches of the superior profunda and muscular arteries.

LIGATURE OF THE BRACHIAL ARTERY

Surgical line.—The inner edge of the coraco-brachialis and biceps muscles.

Surgical anatomy—Anterior relations.—Superficial structures and edge of the biceps in the middle of the arm. At the elbow it is crossed by the bicipital fascia, superficial to which lie the median basilic vein and internal cutaneous nerve. The median nerve crosses it about the middle of the arm.

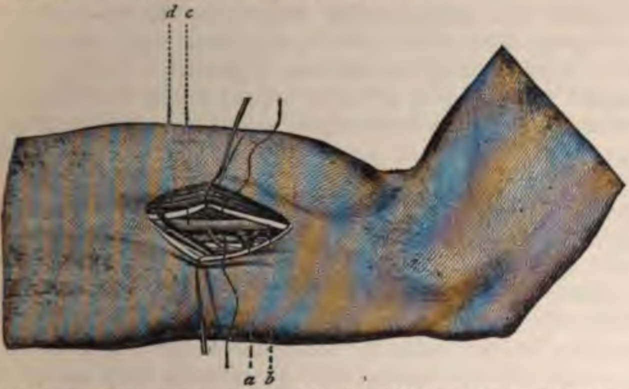

FIG. 17.—Ligature of the left brachial artery in the middle or the arm. *a*, venæ comites; *b*, median nerve; *c*, artery; *d*, biceps (Follin).

Posterior relations.—Long and inner heads of the triceps, coraco-brachialis muscle above, and brachialis anticus below. The musculo-spiral nerve and superior profunda artery.

External relations.—Coraco-brachialis, biceps, and the median nerve as far as the middle of the arm.

Internal relations.—The ulnar and internal cutaneous nerves in the upper, and the median in the lower half. The basilic vein is well to the inner side and some distance from the artery. Venæ comites accompany the brachial and communicate across it.

Operation in the middle of the arm at the seat of election—Position.—See Axillary Artery (p. 75).

First stage.—Make an incision about two and a half inches long on the inner edge of the biceps, define the edge of the muscle, and hook it outwards.

Second stage.—The median nerve is cleared by a little careful dissection and drawn inwards or outwards according to the position it holds with regard to the artery.

Third stage.—The artery being identified the sheath is opened, the veins separated, and the needle passed from the side to which the median nerve has been drawn.

Fourth stage.—Clean and close the wound. The arm should be kept at rest on a pillow.

Operation at the bend of the elbow (Fig. 13, *a*, p. 80)—**First stage.**—Make a 2-inch incision along the inner edge of the biceps tendon and hook aside the median basilic vein and internal cutaneous nerve. The deep fascia, reinforced by the bicipital, is now exposed and divided. The bicipital fascia should be cut as little as possible, the incision being placed high enough up to avoid it altogether if circumstances will permit.

Second stage.—The artery, accompanied by its veins, is now seen with the median nerve close to its inner side. The venæ comites are separated, the artery cleaned, and the needle passed from within outwards.

Third stage.—Cleanse and close the wound.

Collateral circulation.—If the ligature is above the profundæ collateral circulation is carried on by branches of the circumflex and subscapular arteries above, with ascending branches of the superior profunda and muscular vessels below. If the ligature is between the two profundæ, the anastomoses between these and the ulnar, radial, and interosseous recurrent arteries carry on the blood supply.

Ligature at the bend of the elbow places the anastomotic artery above the point of ligature.

LIGATURE OF THE RADIAL ARTERY IN THE FOREARM

Surgical line.—From a point midway between the condyles of the humerus to the styloid process of the radius.

Surgical anatomy—Anterior relations.—Supinator longus muscle in the upper part, in the lower half the vessel is superficial.

Posterior relations.—From above down the biceps tendon, supinator brevis, pronator radii teres, flexor sublimis digitorum, flexor longus pollicis, pronator quadratus muscles, and finally the radius.

External relations.—Supinator longus. The radial nerve lies close to the artery in the middle of the forearm.

Internal relations.—Pronator radii teres and flexor carpi radialis muscles. Venæ comites accompany the radial and communicate in front of it by numerous branches.

Seat of operation.—At the wrist or in the upper third.

Operation at the wrist (Fig. 18, *c*, p. 80).—The forearm being supinated, make an incision about an inch and a half long over the pulse midway between the supinator longus and flexor carpi radialis tendons. If the radial vein is seen it must be hooked aside; the thin deep fascia is picked up and opened, and the artery separated from its veins if possible. The needle may be passed from either side.

Operation in the upper third of the forearm (Fig. 18, *b*, p. 80)—**First stage.**—Make an incision about two and a half inches long in the line of the artery, taking care to avoid any cutaneous veins which may be present. Divide the deep fascia at the edge of the supinator longus muscle, a bluish-white line sometimes indicating the situation. Define the edge of the muscle and draw it outwards.

Second stage.—The artery and its veins are now seen lying on the tendon of the pronator teres. The needle is passed from without inwards, the veins being included if they cannot be readily separated.

Third stage.—Replace the muscle and close the wound.

Collateral circulation.—The blood is conveyed by the other arteries of the forearm.

LIGATURE OF THE RADIAL ARTERY IN THE "SNUFF-BOX"

Make an incision midway between the tendons of the extensor primi and secundi internodii pollicis muscles extending from the lower end of the radius to the base of the metacarpal bone. Divide the skin carefully, expose and hook aside the radial vein, open the fascia and feel for the vessel which crosses the wound obliquely; a small branch of the radial nerve may be met with and should be drawn aside. Pass the needle from either side without attempting to separate the companion veins.

LIGATURE OF THE ULNAR ARTERY IN THE FOREARM

Surgical line.—Draw a line from the tip of the internal condyle of the humerus to the radial side of the pisiform bone. From the middle of the bend of the elbow draw a line to the junction of the upper and middle thirds of the first line. This line and the lower two-thirds of the first mark the ulnar artery.

Surgical anatomy—**Anterior relations.**—The superficial flexors. At its origin it is crossed by the median nerve, and in the lower half it is concealed by the tendon of the flexor carpi ulnaris.

Posterior relations.—The brachialis anticus in the upper part, and flexor profundus digitorum muscle in the rest of its extent.

Internal relations.—The flexor carpi ulnaris muscle. The nerve joins the artery at the junction of the upper and middle thirds, and lies close to it on the inner side.

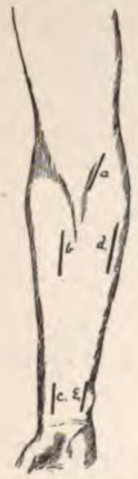

FIG. 18.—Line of incision for ligature of (*a*) the brachial at the bend of the elbow, (*b*) the radial in its upper third, (*c*) at the wrist, (*d*) the ulnar in its upper third, and (*e*) at the wrist.

External relations.—The flexor sublimis digitorum muscle. Venæ comites accompany the artery, and frequently communicate across it.

Seat of operation and position.—As for the radial artery (p. 79).

Operation at the wrist (Fig. 18, *e*)—**First stage.**—An incision about an inch and a half long is made just external to the tendon of the flexor carpi ulnaris muscle, any superficial veins being avoided. The deep fascia is divided, and the wrist being flexed, the tendon is hooked inwards.

Second stage.—Hook the ulnar nerve inwards if necessary. The artery, with its venæ comites, and having the ulnar nerve close to its inner side, is now exposed. The needle is passed from within outwards; the veins may be included if necessary.

Operation in the middle of the forearm (Fig. 18, *d*)—**First stage.**—Make an incision about three inches long in a line drawn from the front of the inner condyle to the outer margin of the pisiform bone. The deep fascia is now divided. A white line is sometimes present indicating the edge of the flexor carpi ulnaris; if this can be recognised, the fascia should be opened along it. The space between the flexor carpi ulnaris and flexor sublimis digitorum is now opened, and the muscles must be relaxed by flexing the wrist; draw these apart, and the ulnar nerve comes into view.

Second stage.—Hook the nerve inwards, the artery will be seen coursing obliquely inwards accompanied by its veins; pass the needle from within outwards, including the veins in the ligature if they are not easily separated.

Third stage.—Replace the structures and close the wound.

Difficulties.—If the incision is made too far to the radial side, the interspace between the flexor sublimis digitorum and palmaris longus muscles may be opened in mistake, and the artery missed.

Collateral circulation.—The blood is conveyed by the other arteries of the forearm.

LIGATURE OF THE ARTERIES OF THE ABDOMEN

LIGATURE OF THE ABDOMINAL AORTA

Seat of ligature.—Between the origin of the inferior mesenteric artery and the bifurcation.

Operation.—The same steps are necessary as for ligature of the common iliac, the incision being carried rather higher up above the umbilicus.

Collateral circulation.—By the internal mammary, intercostals, and lumbar arteries, anastomosing with the epigastric, ilio-lumbar, and circumflex-iliac arteries; and by the inferior mesenteric with the hæmorrhoidals and branches of the internal pudic artery.

LIGATURE OF THE COMMON ILIAC ARTERY

Surgical line.—From a point a finger's breadth below and to the left of the umbilicus to one midway between the symphysis pubis and anterior superior iliac spine. The upper third indicates the position of the common iliac artery, the lower two-thirds that of the external iliac.

Surgical anatomy—Anterior relations.—Peritoneum, intestines, and branches of the sympathetic nerve. The ureter crosses at the point of bifurcation. On the left side the superior hæmorrhoidal artery and rectum.

Posterior relations.—On the right side both common iliac veins lie behind the artery; on the left the left vein is posterior.

External relations.—On both sides the psoas magnus muscle. On the right the companion vein and commencement of the inferior vena cava lie between the artery and muscle.

Internal relations.—The vein lies to the inner side of the common iliac, and on the right side the right and left veins pass behind.

Operation.—The incision is the same as that for ligature of the external iliac by Abernethy's method (p. 83), but is carried higher up and curved towards the umbilicus. The abdominal wall is divided and the peritoneum reflected, as in ligature of the external iliac, which vessel may be traced upwards until the common trunk is arrived at. The artery must be carefully cleaned, and care taken not to wound the large vein in its neighbourhood. The needle should be passed from within out.

The common iliac and the aorta may also be ligatured through an incision in the loin, extending from the tip of the last rib to the iliac crest, and along this to a point just internal to the anterior superior iliac spine. The parietes are divided, and the vessel exposed by separating the peritoneum and pushing it towards the middle line. The transperitoneal operation may also be adopted (p. 85).

Collateral circulation.—By the anastomoses between the internal mammary, deep epigastric, and lumbar arteries, with the ilio-lumbar and circumflex iliac. The visceral branches of the internal iliac anastomose with those of the opposite side, and the lateral with the middle sacral. Also the hæmorrhoidal branches of the internal iliac anastomose with the superior hæmorrhoidal from the inferior mesenteric.

LIGATURE OF THE INTERNAL ILIAC ARTERY

Surgical anatomy—**Anterior relations.**—Ureter and peritoneum. Rectum on the left side.

Posterior relations.—Pyriformis, lumbo-sacral cord, and the vein.

External relations.—Psoas magnus. Pelvic wall.

Internal relations.—The vein. Pyriformis muscle and sacral nerves.

Operation.—Make an incision as for ligature of the external iliac (p. 83), commencing it a little higher up. Conduct the operation as for that vessel. By tracing the course of the external iliac upwards the internal will be found. Clean the vessel carefully, and pass the needle from within outwards.

Collateral circulation.—By the vessels of the opposite side, the lumbar arteries and the anastomoses of the obturator, gluteal, sciatic, and pudic vessels, with branches of the femoral.

LIGATURE OF THE GLUTEAL ARTERY

Surgical line.—Draw a line from the posterior superior iliac spine to the great trochanter, the limb being slightly flexed and rotated in, the junction of the upper with the middle third of the line marks the point of emergence of the artery from the sciatic notch.

Surgical anatomy.—The vessel leaves the pelvis at the upper border of the pyriformis between it and the gluteus minimus muscle, and is covered by the gluteus medius and maximus, the superficial branch lying between these muscles. The superior gluteal nerve lies below and external.

Operation.—The patient is rolled well over, so that the limb hangs over the side of the table. Make a free incision from the posterior superior iliac spine in a line to the upper part of the great trochanter. Separate the fibres of the gluteus maximus with the handle of the scalpel, and the edges of the gluteus medius and pyriformis, dividing these if necessary. Trace the artery as far to the cardiac side as possible, in order to avoid passing the ligature close to its point of bifurcation. Pass the needle from the nerve, including the veins, unless they can be easily separated.

Collateral circulation. — Through the sciatic artery and branches of the profunda femoris.

LIGATURE OF THE EXTERNAL ILIAC ARTERY

Surgical line.—See Ligature of the Common Iliac (p. 81).

Surgical anatomy—Anterior relations.—Peritoneum and a prolongation of the iliac fascia; close to Poupart's ligament, the deep circumflex iliac vein, the spermatic vessels, and vas deferens. The ureter crosses the artery at its origin, and the genital branch of the genito-crural nerve lies on the sheath. The left artery is crossed by the sigmoid flexure, the right by the end of the ileum.

Posterior relations.—Psoas magnus, and on the inner side the vein.

External relations.—Psoas magnus and fascia.

Internal relations.—The vein.

Abernethy's operation (Fig. 19, *b*, p. 84)—**Position of the patient.**—Dorsal, with the thighs supported by a pillow.

First stage.—Make a curved incision from a point an inch above and an inch internal to the anterior superior iliac spine, to a point opposite the middle of Poupart's ligament or slightly external to it. Successively divide the three muscles in the abdominal wall, being careful when the transversalis is reached that the underlying transversalis fascia is not divided with it; otherwise the peritoneum, which lies immediately beneath, may be mistaken for this fascia and opened. Except in very thin patients, a thin layer of fat intervenes between the transversalis muscle and fascia; the transversalis fascia is carefully picked up and opened, and the subperitoneal fat and peritoneum exposed. This is best done first near Poupart's ligament, where there is least danger of wounding the peritoneum.

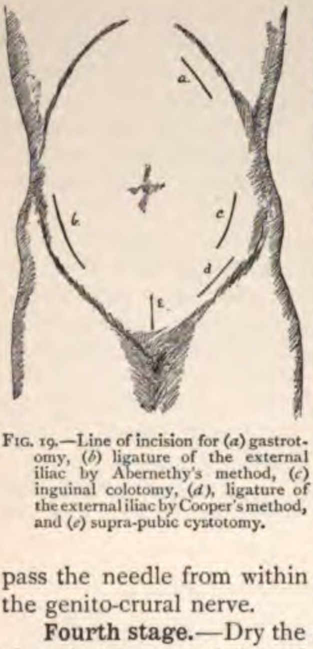

FIG. 19.—Line of incision for (*a*) gastrotomy, (*b*) ligature of the external iliac by Abernethy's method, (*c*) inguinal colotomy, (*d*), ligature of the external iliac by Cooper's method, and (*e*) supra-pubic cystotomy.

Second stage.—Separate the peritoneum with the fingers and push it over to the middle line, the ureter going with it. Have the wound held well open with deep retractors and feel for the vessel at the brim of the pelvis.

Third stage.—Carefully clean the vessel in the middle of its course and pass the needle from within outwards, being careful not to include the genito-crural nerve.

Fourth stage.—Dry the wound, suture the muscular layers with chromic catgut, and close the wound with silkworm gut.

Cooper's operation (Fig. 19, *d*)—**First stage.**—Make an incision about a finger's breadth above Poupart's ligament, beginning just external to the spine of the pubes, the centre of the incision being opposite the line of the artery; divide the external oblique and as much of the internal as may appear in the wound.

Second stage.—The wound being held well open, the areolar tissue is torn through with two pairs of forceps, the spermatic cord defined and hooked upwards.

Third stage.—Tear through the transversalis fascia, and with a broad spatula hold the upper part of the wound well up so that the cord, deep epigastric artery, and peritoneum are well drawn aside and protected from injury; carefully clean the artery and pass the needle from within outwards.

Fourth stage.—Replace the structures, suture the external oblique with chromic catgut and close the wound.

Abernethy's operation is the one usually performed, since by it the whole of the artery is exposed, and the surgeon may therefore select the most healthy part for the application of the ligature, whereas by Cooper's method only the lower inch of the vessel is exposed, and this close to the origin of its branches. Abernethy's operation inflicts, however, greater damage on the abdominal wall, and consequently there is more likelihood of subsequent hernia from yielding of the cicatrix.

Transperitoneal operation.—The aorta and iliac arteries may be reached by an incision into the abdominal cavity made in the middle line or in the linea semilunaris. The wound being held well open, the intestines are pushed aside and protected by a flat sponge; the peritoneum over the artery is divided to a small extent and the vessel is secured.

Collateral circulation.—By the free anastomoses between the branches of the internal iliac with those of the profunda femoris. The internal mammary and lumbar arteries also anastomose with the deep epigastric and circumflex iliac respectively.

LIGATURE OF THE ARTERIES OF THE LOWER LIMB

LIGATURE OF THE COMMON FEMORAL ARTERY

The common femoral may be ligatured just below Poupart's ligament, where it is contained in the crural sheath, through an incision about two inches long, a finger's breadth below the ligament, and parallel with it, *i.e.* transversely to the artery (Fig. 21, *a*, p. 87). Divide the fascia lata and expose the anterior layer of the crural sheath. Open the compartment containing the artery, clean the vessel, and pass the needle from within outwards. The collateral circulation is the same as after-ligature of the external iliac, the deep epigastric and circumflex iliac arteries being, however, above the point of deligation.

LIGATURE OF THE FEMORAL ARTERY IN SCARPA'S TRIANGLE

Surgical line.—From a point midway between the anterior superior iliac spine and the symphysis pubis to the most prominent point of the inner condyle, the thigh being abducted and rotated outwards and the knee semi-flexed.

Surgical anatomy in Scarpa's triangle—Anterior relations.—Superficial structures and fascia lata. At the apex of the space the artery is crossed by the sartorius muscle and internal cutaneous nerve.

Posterior relations.—The psoas, pectineus, and adductor brevis muscles. At the upper part is the nerve to the pectineus. At the apex of the space the femoral vein passes from within outwards. The profunda vessels intervene between the artery and the adductor brevis muscle.

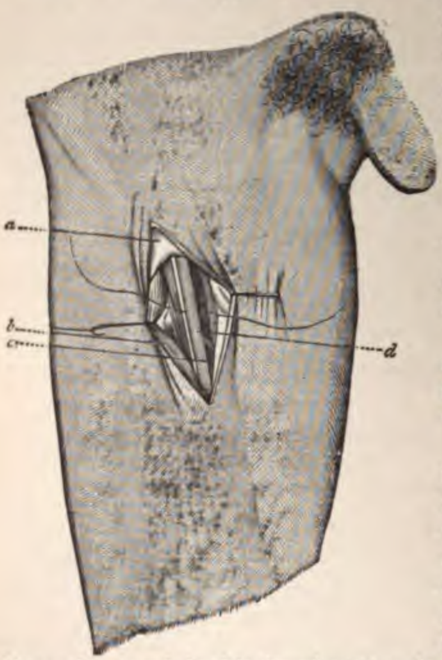

FIG. 20.—Ligature of the right femoral artery at the apex of Scarpa's triangle. *a*, deep fascia; *b*, sartorius; *c*, femoral vein; *d*, artery (Follin).

External relations.—The anterior crural nerve.

Internal relations.—The femoral vein which passes behind the artery at the apex of the space.

Operation—Position of patient.—The thigh is abducted, rotated outwards, and slightly flexed.

First stage.—Make an incision about three inches long in the line of the artery, the centre corresponding to the apex of Scarpa's triangle, which is about a hand's breadth below Poupart's ligament. If the internal saphenous vein is seen draw it aside. Open the deep fascia, define the inner edge of the sartorius, and hook the muscle outwards.

Second stage.—The situation of the artery is now determined by the finger. The internal cutaneous nerve crosses the vessel at this point, and if seen should be hooked aside. Open the sheath, clean the vessel, and pass the needle from within outwards.[1]

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[1] The direction to pass the needle from within out is usually insisted upon. It is, however, to be observed that at the apex of Scarpa's triangle the vein (which this direction is aimed at avoiding) usually lies behind the artery, and therefore in this situation it is equally endangered from whichever side the needle be passed, and consequently the surgeon should aim at avoiding the next most important structure, *i.e.* the anterior crural nerve, and should pass the needle from without inwards.

Third stage.—Dry and close the wound.

Difficulties.—The origin of the profunda is liable to variation, and if the branches are scattered over the femoral at the point of ligature, those in the way should also be secured.

Collateral circulation (Fig. 12, p. 40).—The profunda artery replaces the femoral. It anastomoses by its branches with muscular branches of the femoral and popliteal arteries, with the anastomotica magna, and with the upper articular branches of the popliteal.

LIGATURE OF THE FEMORAL ARTERY IN HUNTER'S CANAL

Surgical line.—See femoral in Scarpa's triangle (p. 85).

Anatomy.—Hunter's canal occupies the middle third of the thigh.

Anterior relations.—Superficial structures and deep fascia, sartorius muscle, and the aponeurotic covering of the canal. The long saphenous nerve lies in close contact with the vessel.

Posterior relations.—Adductor longus and magnus muscles.

External relations.—Vastus internus muscle and femoral vein, and for a short distance the long saphenous nerve.

Internal relations.—Adductor longus and magnus muscles, and the sartorius below.

Operation—Position of patient as for ligature in Scarpa's triangle (p. 86).

First stage.—Make an incision three inches long in the line of the artery in the middle of the thigh (Fig. 21, *c*). The saphenous vein if seen is drawn inwards and the deep fascia divided. Define the outer edge of the sartorius muscle and draw it inwards, exposing the tendinous covering of Hunter's canal.

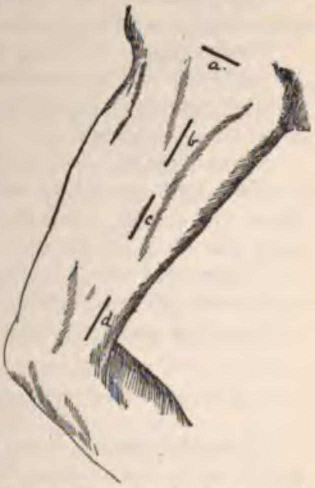

FIG. 21.—Line of incision for ligature of (*a*) the common femoral, (*b*) the femoral at the apex of Scarpa's triangle, (*c*) in Hunter's canal, and (*d*) the popliteal artery.

Second stage.—Divide the aponeurosis carefully, thereby opening Hunter's canal. Feel for the vessel and hook outwards the saphenous nerve. Open the sheath, clean the artery, and pass the needle from without inwards.

Collateral circulation.—See ligature in Scarpa's triangle (p. 87).

LIGATURE OF THE POPLITEAL ARTERY

Surgical anatomy—Anterior relations.—Femur; posterior ligament of the knee-joint and popliteus muscle.

Posterior relations.—Hamstrings above, calf muscles below. Popliteal vein and internal popliteal nerve in the centre of the space and the branch of obturator nerve above.

Laterally.—Hamstrings and calf muscles and a quantity of fat. At the upper part the nerve and vein are external.

Seat of ligature.—Preferably at the upper part from the inner side; also above or below by a posterior incision into the space.

Operation from the inner side (Fig. 21, *d*, p. 87)—**Position.**—Knee semiflexed, and the limb rotated outwards.

First stage.—Make an incision three inches along parallel with the adductor magnus tendon, commencing at the junction of the middle and lower thirds of the thigh. Define the tendon of the adductor magnus muscle.

Second stage.—Separate the adductor magnus and hamstring tendons, and the artery will be found just behind the former. Open the sheath, clean the vessel, and pass the needle from the outer side to avoid the vein and nerve.

Collateral circulation.—The anastomotica magna and the upper articular arteries above, anastomosing with the lower articulars and anterior tibial recurrent below the point of ligature.

LIGATURE OF THE POSTERIOR TIBIAL ARTERY IN THE LEG

Surgical line.—From the centre of the popliteal space to midway between the tendo Achillis and the internal malleolus.

Surgical anatomy—Anterior relations.—From above down the artery lies on the tibialis posticus and flexor longus digitorum muscles, the tibia, and the ankle joint.

Posterior relations.—Above the soleus and gastrocnemius muscles, below deep fascia, annular ligament, and integument only. The posterior tibial nerve crosses the artery above.

External relations.—Along the lower two-thirds of the vessel the posterior tibial nerve.

Internal relations.—In the upper third, the posterior tibial nerve. Venæ comites accompany the vessel, and unite by branches across it.

Operation — **Position.** — Semiflex the knee, and place the leg on its outer side.

First stage. — Make an incision three and a half inches long in the middle of the leg, slightly behind the inner margin of the tibia. Open the deep fascia, define the free edge of the gastrocnemius, and draw it aside.

Second stage.—Divide that portion of the soleus which arises from the inner border of the tibia, and open up the space between this muscle and the deep layer.

Third stage.—The fascia covering the flexor longus digitorum muscle is now divided, and the artery sought for with the finger. The nerve lies to its outer side. Do not attempt to separate the venæ comites, but pass the needle from the nerve if possible.

Fourth stage.—Dry the wound and close it.

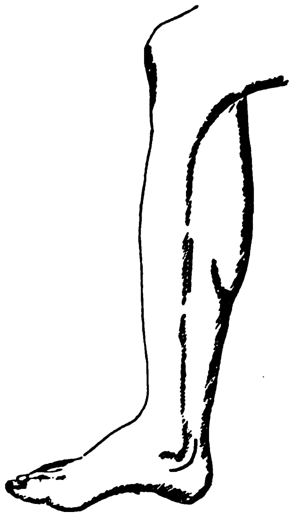

FIG. 22.—Lines of incision for ligature of the posterior tibial artery in the middle of the leg and behind the inner malleolus.

LIGATURE OF THE POSTERIOR TIBIAL ARTERY AT THE ANKLE

Surgical anatomy.—The structures behind the inner ankle are from before backwards the tendons of the tibialis posticus and flexor longus digitorum muscles, the posterior tibial artery and veins, the nerve, and the tendon of the flexor longus hallucis.

Operation (Fig. 22).—Make a curved incision one finger's breadth behind the inner malleolus, the concavity of the curve being forwards. Divide the internal annular ligament, and the artery, with the nerve behind it, *i.e.* nearer the heel, will be exposed. Separate the veins if possible, and pass the needle from behind forwards.

Collateral circulation.—The anterior tibial and peroneal vessels maintain free circulation through the leg and foot.

Second stage.—The median nerve is cleared by a little careful dissection and drawn inwards or outwards according to the position it holds with regard to the artery.

Third stage.—The artery being identified the sheath is opened, the veins separated, and the needle passed from the side to which the median nerve has been drawn.

Fourth stage.—Clean and close the wound. The arm should be kept at rest on a pillow.

Operation at the bend of the elbow (Fig. 13, *a*, p. 80)—**First stage.**—Make a 2-inch incision along the inner edge of the biceps tendon and hook aside the median basilic vein and internal cutaneous nerve. The deep fascia, reinforced by the bicipital, is now exposed and divided. The bicipital fascia should be cut as little as possible, the incision being placed high enough up to avoid it altogether if circumstances will permit.

Second stage.—The artery, accompanied by its veins, is now seen with the median nerve close to its inner side. The venæ comites are separated, the artery cleaned, and the needle passed from within outwards.

Third stage.—Cleanse and close the wound.

Collateral circulation.—If the ligature is above the profundæ collateral circulation is carried on by branches of the circumflex and subscapular arteries above, with ascending branches of the superior profunda and muscular vessels below. If the ligature is between the two profundæ, the anastomoses between these and the ulnar, radial, and interosseous recurrent arteries carry on the blood supply.

Ligature at the bend of the elbow places the anastomotic artery above the point of ligature.

LIGATURE OF THE RADIAL ARTERY IN THE FOREARM

Surgical line.—From a point midway between the condyles of the humerus to the styloid process of the radius.

Surgical anatomy—**Anterior relations.**—Supinator longus muscle in the upper part, in the lower half the vessel is superficial.

Posterior relations.—From above down the biceps tendon, supinator brevis, pronator radii teres, flexor sublimis digitorum, flexor longus pollicis, pronator quadratus muscles, and finally the radius.

External relations.—Supinator longus. The radial nerve lies close to the artery in the middle of the forearm.

Internal relations.—Pronator radii teres and flexor carpi radialis muscles. Venæ comites accompany the radial and communicate in front of it by numerous branches.

Seat of operation.—At the wrist or in the upper third.

Operation at the wrist (Fig. 18, *c*, p. 80).—The forearm being supinated, make an incision about an inch and a half long over the pulse midway between the supinator longus and flexor carpi radialis tendons. If the radial vein is seen it must be hooked aside; the thin deep fascia is picked up and opened, and the artery separated from its veins if possible. The needle may be passed from either side.

Operation in the upper third of the forearm (Fig. 18, *b*, p. 80)—**First stage.**—Make an incision about two and a half inches long in the line of the artery, taking care to avoid any cutaneous veins which may be present. Divide the deep fascia at the edge of the supinator longus muscle, a bluish-white line sometimes indicating the situation. Define the edge of the muscle and draw it outwards.

Second stage.—The artery and its veins are now seen lying on the tendon of the pronator teres. The needle is passed from without inwards, the veins being included if they cannot be readily separated.

Third stage.—Replace the muscle and close the wound.

Collateral circulation.—The blood is conveyed by the other arteries of the forearm.

LIGATURE OF THE RADIAL ARTERY IN THE "SNUFF-BOX"

Make an incision midway between the tendons of the extensor primi and secundi internodii pollicis muscles extending from the lower end of the radius to the base of the metacarpal bone. Divide the skin carefully, expose and hook aside the radial vein, open the fascia and feel for the vessel which crosses the wound obliquely; a small branch of the radial nerve may be met with and should be drawn aside. Pass the needle from either side without attempting to separate the companion veins.

LIGATURE OF THE ULNAR ARTERY IN THE FOREARM

Surgical line.—Draw a line from the tip of the internal condyle of the humerus to the radial side of the pisiform bone. From the middle of the bend of the elbow draw a line to the junction of the upper and middle thirds of the first line. This line and the lower two-thirds of the first mark the ulnar artery.

Surgical anatomy—Anterior relations.—The superficial flexors. At its origin it is crossed by the median nerve, and in the lower half it is concealed by the tendon of the flexor carpi ulnaris.

Posterior relations.—The brachialis anticus in the upper part, and flexor profundus digitorum muscle in the rest of its extent.

Internal relations.—The flexor carpi ulnaris muscle. The nerve joins the artery at the junction of the upper and middle thirds, and lies close to it on the inner side.

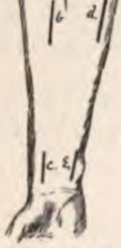

FIG. 18.—Line of incision for ligature of (*a*) the brachial at the bend of the elbow, (*b*) the radial in its upper third, (*c*) at the wrist, (*d*) the ulnar in its upper third, and (*e*) at the wrist.

External relations.—The flexor sublimis digitorum muscle. Venæ comites accompany the artery, and frequently communicate across it.

Seat of operation and position.—As for the radial artery (p. 79).

Operation at the wrist (Fig. 18, *e*)—**First stage.**—An incision about an inch and a half long is made just external to the tendon of the flexor carpi ulnaris muscle, any superficial veins being avoided. The deep fascia is divided, and the wrist being flexed, the tendon is hooked inwards.

Second stage.—Hook the ulnar nerve inwards if necessary. The artery, with its venæ comites, and having the ulnar nerve close to its inner side, is now exposed. The needle is passed from within outwards; the veins may be included if necessary.

Operation in the middle of the forearm (Fig. 18, *d*)—**First stage.**—Make an incision about three inches long in a line drawn from the front of the inner condyle to the outer margin of the pisiform bone. The deep fascia is now divided. A white line is sometimes present indicating the edge of the flexor carpi ulnaris; if this can be recognised, the fascia should be opened along it. The space between the flexor carpi ulnaris and flexor sublimis digitorum is now opened, and the muscles must be relaxed by flexing the wrist; draw these apart, and the ulnar nerve comes into view.

Second stage.—Hook the nerve inwards, the artery will be seen coursing obliquely inwards accompanied by its veins; pass the needle from within outwards, including the veins in the ligature if they are not easily separated.

Third stage.—Replace the structures and close the wound.

Difficulties.—If the incision is made too far to the radial side, the interspace between the flexor sublimis digitorum and palmaris longus muscles may be opened in mistake, and the artery missed.

Collateral circulation.—The blood is conveyed by the other arteries of the forearm.

LIGATURE OF THE ARTERIES OF THE ABDOMEN

LIGATURE OF THE ABDOMINAL AORTA

Seat of ligature.—Between the origin of the inferior mesenteric artery and the bifurcation.

Operation.—The same steps are necessary as for ligature of the common iliac, the incision being carried rather higher up above the umbilicus.

Collateral circulation.—By the internal mammary, intercostals, and lumbar arteries, anastomosing with the epigastric, ilio-lumbar, and circumflex-iliac arteries; and by the inferior mesenteric with the hæmorrhoidals and branches of the internal pudic artery.

LIGATURE OF THE COMMON ILIAC ARTERY

Surgical line.—From a point a finger's breadth below and to the left of the umbilicus to one midway between the symphysis pubis and anterior superior iliac spine. The upper third indicates the position of the common iliac artery, the lower two-thirds that of the external iliac.

Surgical anatomy—**Anterior relations.**—Peritoneum, intestines, and branches of the sympathetic nerve. The ureter crosses at the point of bifurcation. On the left side the superior hæmorrhoidal artery and rectum.

Posterior relations.—On the right side both common iliac veins lie behind the artery; on the left the left vein is posterior.

External relations.—On both sides the psoas magnus muscle. On the right the companion vein and commencement of the inferior vena cava lie between the artery and muscle.

Internal relations.—The vein lies to the inner side of the common iliac, and on the right side the right and left veins pass behind.

Operation.—The incision is the same as that for ligature of the external iliac by Abernethy's method (p. 83), but is carried higher up and curved towards the umbilicus. The abdominal wall is divided and the peritoneum reflected, as in ligature of the external iliac, which vessel may be traced upwards until the common trunk is arrived at. The artery must be carefully cleaned, and care taken not to wound the large vein in its neighbourhood. The needle should be passed from within out.

The common iliac and the aorta may also be ligatured through an incision in the loin, extending from the tip of the last rib to the iliac crest, and along this to a point just internal to the anterior superior iliac spine. The parietes are divided, and the vessel exposed by separating the peritoneum and pushing it towards the middle line. The transperitoneal operation may also be adopted (p. 85).

Collateral circulation.—By the anastomoses between the internal mammary, deep epigastric, and lumbar arteries, with the ilio-lumbar and circumflex iliac. The visceral branches of the internal iliac anastomose with those of the opposite side, and the lateral with the middle sacral. Also the hæmorrhoidal branches of the internal iliac anastomose with the superior hæmorrhoidal from the inferior mesenteric.

LIGATURE OF THE INTERNAL ILIAC ARTERY

Surgical anatomy—Anterior relations.—Ureter and peritoneum. Rectum on the left side.

Posterior relations.—Pyriformis, lumbo-sacral cord, and the vein.

External relations.—Psoas magnus. Pelvic wall.

Internal relations.—The vein. Pyriformis muscle and sacral nerves.

Operation.—Make an incision as for ligature of the external iliac (p. 83), commencing it a little higher up. Conduct the operation as for that vessel. By tracing the course of the external iliac upwards the internal will be found. Clean the vessel carefully, and pass the needle from within outwards.

Collateral circulation.—By the vessels of the opposite side, the lumbar arteries and the anastomoses of the obturator, gluteal, sciatic, and pudic vessels, with branches of the femoral.

LIGATURE OF THE GLUTEAL ARTERY

Surgical line.—Draw a line from the posterior superior iliac spine to the great trochanter, the limb being slightly flexed and rotated in, the junction of the upper with the middle third of the line marks the point of emergence of the artery from the sciatic notch.

Surgical anatomy.—The vessel leaves the pelvis at the upper border of the pyriformis between it and the gluteus minimus muscle, and is covered by the gluteus medius and maximus, the superficial branch lying between these muscles. The superior gluteal nerve lies below and external.

Operation.—The patient is rolled well over, so that the limb hangs over the side of the table. Make a free incision from the posterior superior iliac spine in a line to the upper part of the great trochanter. Separate the fibres of the gluteus maximus with the handle of the scalpel, and the edges of the gluteus medius and pyriformis, dividing these if necessary. Trace the artery as far to the cardiac side as possible, in order to avoid passing the ligature close to its point of bifurcation. Pass the needle from the nerve, including the veins, unless they can be easily separated.

Collateral circulation. — Through the sciatic artery and branches of the profunda femoris.

LIGATURE OF THE EXTERNAL ILIAC ARTERY

Surgical line.—See Ligature of the Common Iliac (p. 81).

Surgical anatomy—Anterior relations.—Peritoneum and a prolongation of the iliac fascia; close to Poupart's ligament, the deep circumflex iliac vein, the spermatic vessels, and vas deferens. The ureter crosses the artery at its origin, and the genital branch of the genito-crural nerve lies on the sheath. The left artery is crossed by the sigmoid flexure, the right by the end of the ileum.

Posterior relations.—Psoas magnus, and on the inner side the vein.

External relations.—Psoas magnus and fascia.

Internal relations.—The vein.

Abernethy's operation (Fig. 19, *b*, p. 84)—**Position of the patient.**—Dorsal, with the thighs supported by a pillow.

First stage.—Make a curved incision from a point an inch above and an inch internal to the anterior superior iliac spine, to a point opposite the middle of Poupart's ligament or slightly external to it. Successively divide the three muscles in the abdominal wall, being careful when the transversalis is reached that the underlying transversalis fascia is not divided with it; otherwise the peritoneum, which lies immediately beneath, may be mistaken for this fascia and opened. Except in very thin patients, a thin layer of fat intervenes between the transversalis muscle and fascia; the transversalis fascia is carefully picked up and opened, and the subperitoneal fat and peritoneum exposed. This is best done first near Poupart's ligament, where there is least danger of wounding the peritoneum.

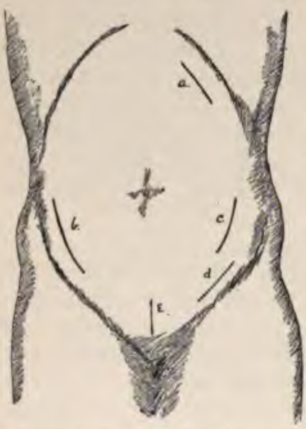

FIG. 19.—Line of incision for (*a*) gastrotomy, (*b*) ligature of the external iliac by Abernethy's method, (*c*) inguinal colotomy, (*d*), ligature of the external iliac by Cooper's method, and (*e*) supra-pubic cystotomy.

Second stage.—Separate the peritoneum with the fingers and push it over to the middle line, the ureter going with it. Have the wound held well open with deep retractors and feel for the vessel at the brim of the pelvis.

Third stage.—Carefully clean the vessel in the middle of its course and pass the needle from within outwards, being careful not to include the genito-crural nerve.

Fourth stage.—Dry the wound, suture the muscular layers with chromic catgut, and close the wound with silkworm gut.

Cooper's operation (Fig. 19, *d*)—**First stage.**—Make an incision about a finger's breadth above Poupart's ligament, beginning just external to the spine of the pubes, the centre of the incision being opposite the line of the artery; divide the external oblique and as much of the internal as may appear in the wound.

Second stage.—The wound being held well open, the areolar tissue is torn through with two pairs of forceps, the spermatic cord defined and hooked upwards.

Third stage.—Tear through the transversalis fascia, and with a broad spatula hold the upper part of the wound well up so that the cord, deep epigastric artery, and peritoneum are well drawn aside and protected from injury; carefully clean the artery and pass the needle from within outwards.

Fourth stage.—Replace the structures, suture the external oblique with chromic catgut and close the wound.

Abernethy's operation is the one usually performed, since by it the whole of the artery is exposed, and the surgeon may therefore select the most healthy part for the application of the ligature, whereas by Cooper's method only the lower inch of the vessel is exposed, and this close to the origin of its branches. Abernethy's operation inflicts, however, greater damage on the abdominal wall, and consequently there is more likelihood of subsequent hernia from yielding of the cicatrix.

Transperitoneal operation.—The aorta and iliac arteries may be reached by an incision into the abdominal cavity made in the middle line or in the linea semilunaris. The wound being held well open, the intestines are pushed aside and protected by a flat sponge; the peritoneum over the artery is divided to a small extent and the vessel is secured.

Collateral circulation.—By the free anastomoses between the branches of the internal iliac with those of the profunda femoris. The internal mammary and lumbar arteries also anastomose with the deep epigastric and circumflex iliac respectively.

LIGATURE OF THE ARTERIES OF THE LOWER LIMB

LIGATURE OF THE COMMON FEMORAL ARTERY

The common femoral may be ligatured just below Poupart's ligament, where it is contained in the crural sheath, through an incision about two inches long, a finger's breadth below the ligament, and parallel with it, *i.e.* transversely to the artery (Fig. 21, *a*, p. 87). Divide the fascia lata and expose the anterior layer of the crural sheath. Open the compartment containing the artery, clean the vessel, and pass the needle from within outwards. The collateral circulation is the same as after-ligature of the external iliac, the deep epigastric and circumflex iliac arteries being, however, above the point of deligation.

LIGATURE OF THE FEMORAL ARTERY IN SCARPA'S TRIANGLE

Surgical line.—From a point midway between the anterior superior iliac spine and the symphysis pubis to the most prominent point of the inner condyle, the thigh being abducted and rotated outwards and the knee semi-flexed.

Surgical anatomy in Scarpa's triangle—Anterior relations.—Superficial structures and fascia lata. At the apex of the space the artery is crossed by the sartorius muscle and internal cutaneous nerve.

Posterior relations.—The psoas, pectineus, and adductor brevis muscles. At the upper part is the nerve to the pectineus. At the apex of the space the femoral vein passes from within outwards. The profunda vessels intervene between the artery and the adductor brevis muscle.

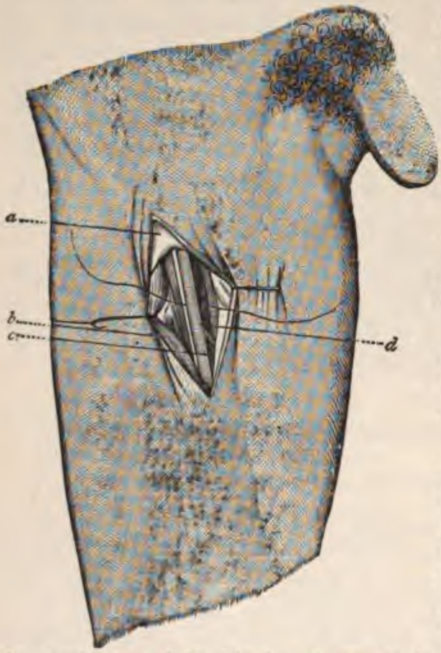

FIG. 20.—Ligature of the right femoral artery at the apex of Scarpa's triangle. *a*, deep fascia; *b*, sartorius; *c*, femoral vein; *d*, artery (Follin).

External relations.—The anterior crural nerve.

Internal relations.—The femoral vein which passes behind the artery at the apex of the space.

Operation—Position of patient.—The thigh is abducted, rotated outwards, and slightly flexed.

First stage.—Make an incision about three inches long in the line of the artery, the centre corresponding to the apex of Scarpa's triangle, which is about a hand's breadth below Poupart's ligament. If the internal saphenous vein is seen draw it aside. Open the deep fascia, define the inner edge of the sartorius, and hook the muscle outwards.

Second stage.—The situation of the artery is now determined by the finger. The internal cutaneous nerve crosses the vessel at this point, and if seen should be hooked aside. Open the sheath, clean the vessel, and pass the needle from within outwards.[1]

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[1] The direction to pass the needle from within out is usually insisted upon. It is, however, to be observed that at the apex of Scarpa's triangle the vein (which this direction is aimed at avoiding) usually lies behind the artery, and therefore in this situation it is equally endangered from whichever side the needle be passed, and consequently the surgeon should aim at avoiding the next most important structure, *i.e.* the anterior crural nerve, and should pass the needle from without inwards.

Third stage.—Dry and close the wound.

Difficulties.—The origin of the profunda is liable to variation, and if the branches are scattered over the femoral at the point of ligature, those in the way should also be secured.

Collateral circulation (Fig. 12, p. 40).—The profunda artery replaces the femoral. It anastomoses by its branches with muscular branches of the femoral and popliteal arteries, with the anastomotica magna, and with the upper articular branches of the popliteal.

LIGATURE OF THE FEMORAL ARTERY IN HUNTER'S CANAL

Surgical line.—See femoral in Scarpa's triangle (p. 85).

Anatomy.—Hunter's canal occupies the middle third of the thigh.

Anterior relations.—Superficial structures and deep fascia, sartorius muscle, and the aponeurotic covering of the canal. The long saphenous nerve lies in close contact with the vessel.

Posterior relations.—Adductor longus and magnus muscles.

External relations.—Vastus internus muscle and femoral vein, and for a short distance the long saphenous nerve.

Internal relations.—Adductor longus and magnus muscles, and the sartorius below.

Operation—Position of patient as for ligature in Scarpa's triangle (p. 86).

First stage.—Make an incision three inches long in the line of the artery in the middle of the thigh (Fig. 21, *c*). The saphenous vein if seen is drawn inwards and the deep fascia divided. Define the outer edge of the sartorius muscle and draw it inwards, exposing the tendinous covering of Hunter's canal.

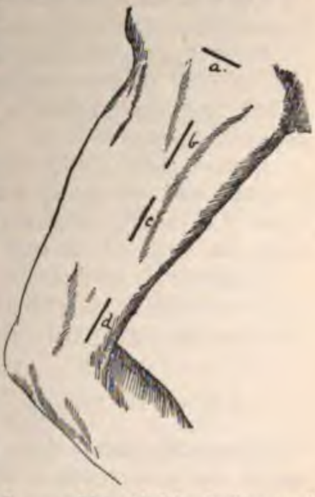

Fig. 21.—Line of incision for ligature of (*a*) the common femoral, (*b*) the femoral at the apex of Scarpa's triangle, (*c*) in Hunter's canal, and (*d*) the popliteal artery.

Second stage.—Divide the aponeurosis carefully, thereby opening Hunter's canal. Feel for the vessel and hook outwards the saphenous nerve. Open the sheath, clean the artery, and pass the needle from without inwards.

Collateral circulation.—See ligature in Scarpa's triangle (p. 87).

LIGATURE OF THE POPLITEAL ARTERY

Surgical anatomy—Anterior relations.—Femur; posterior ligament of the knee-joint and popliteus muscle.

Posterior relations.—Hamstrings above, calf muscles below. Popliteal vein and internal popliteal nerve in the centre of the space and the branch of obturator nerve above.

Laterally.—Hamstrings and calf muscles and a quantity of fat. At the upper part the nerve and vein are external.

Seat of ligature.—Preferably at the upper part from the inner side; also above or below by a posterior incision into the space.

Operation from the inner side (Fig. 21, *d*, p. 87)—**Position.**—Knee semiflexed, and the limb rotated outwards.

First stage.—Make an incision three inches along parallel with the adductor magnus tendon, commencing at the junction of the middle and lower thirds of the thigh. Define the tendon of the adductor magnus muscle.

Second stage.—Separate the adductor magnus and hamstring tendons, and the artery will be found just behind the former. Open the sheath, clean the vessel, and pass the needle from the outer side to avoid the vein and nerve.

Collateral circulation.—The anastomotica magna and the upper articular arteries above, anastomosing with the lower articulars and anterior tibial recurrent below the point of ligature.

LIGATURE OF THE POSTERIOR TIBIAL ARTERY IN THE LEG

Surgical line.—From the centre of the popliteal space to midway between the tendo Achillis and the internal malleolus.

Surgical anatomy—Anterior relations.—From above down the artery lies on the tibialis posticus and flexor longus digitorum muscles, the tibia, and the ankle joint.

Posterior relations.—Above the soleus and gastrocnemius muscles, below deep fascia, annular ligament, and integument only. The posterior tibial nerve crosses the artery above.

External relations.—Along the lower two-thirds of the vessel the posterior tibial nerve.

Internal relations.—In the upper third, the posterior tibial nerve. Venæ comites accompany the vessel, and unite by branches across it.

Operation — **Position.** — Semiflex the knee, and place the leg on its outer side.

First stage. — Make an incision three and a half inches long in the middle of the leg, slightly behind the inner margin of the tibia. Open the deep fascia, define the free edge of the gastrocnemius, and draw it aside.

Second stage.—Divide that portion of the soleus which arises from the inner border of the tibia, and open up the space between this muscle and the deep layer.

Third stage. — The fascia covering the flexor longus digitorum muscle is now divided, and the artery sought for with the finger. The nerve lies to its outer side. Do not attempt to separate the venæ comites, but pass the needle from the nerve if possible.

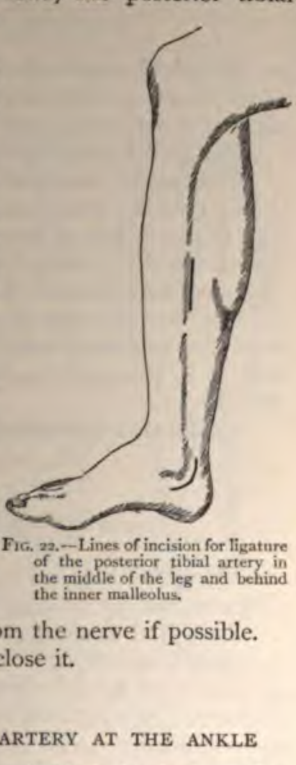

FIG. 22.—Lines of incision for ligature of the posterior tibial artery in the middle of the leg and behind the inner malleolus.

Fourth stage.—Dry the wound and close it.

LIGATURE OF THE POSTERIOR TIBIAL ARTERY AT THE ANKLE

Surgical anatomy.—The structures behind the inner ankle are from before backwards the tendons of the tibialis posticus and flexor longus digitorum muscles, the posterior tibial artery and veins, the nerve, and the tendon of the flexor longus hallucis.

Operation (Fig. 22).—Make a curved incision one finger's breadth behind the inner malleolus, the concavity of the curve being forwards. Divide the internal annular ligament, and the artery, with the nerve behind it, *i.e.* nearer the heel, will be exposed. Separate the veins if possible, and pass the needle from behind forwards.

Collateral circulation.—The anterior tibial and peroneal vessels maintain free circulation through the leg and foot.

LIGATURE OF THE PERONEAL ARTERY

Surgical anatomy.—The vessel lies on the posterior surface of the fibula, in a tendinous canal beneath the flexor longus hallucis muscle, and is accompanied by venæ comites.

Seat of ligature.—Middle of the leg.

Operation—**Position.**—Thigh adducted, knee semiflexed, and the foot resting on its inner border. Make an incision three inches long in the middle of the leg on to the outer border of the fibula. When the deep fascia has been divided, the soleus muscle comes into view, and must be drawn inwards. The flexor longus hallucis is now carefully peeled off the posterior surface of the fibula until the tendinous canal containing the artery is exposed. The needle is passed from either side, the veins being included in the ligature.

Collateral circulation.—By the anterior and posterior tibials.

LIGATURE OF THE ANTERIOR TIBIAL ARTERY

Surgical line.—From the inner margin of the head of the fibula to midway between the two malleoli.

Surgical anatomy—**Anterior relations.**—The artery is at first deeply placed, but becomes more superficial as it descends. It is overlapped by the tibialis anticus and extensor longus digitorum muscles. At the junction of the upper and middle thirds of the leg the extensor proprius hallucis is placed between the vessel and the digitorum muscle, and in the lower third crosses the artery to the inner side.

The anterior tibial nerve lies in front of the vessel in its middle third.

Posterior relations.—Interosseous membrane, tibia, and ankle joint.

External relations.—Extensor longus digitorum in the upper third, below the extensor proprius hallucis. The nerve lies external to the artery above and below.

Internal relations.—Tibialis anticus muscle, and in the lower third the extensor proprius hallucis.

Venæ comites accompany the artery and communicate by cross branches.

Seat of ligature.—Lower half of the leg (Fig. 23, *b*).

Operation—Position.—Leg extended and rotated inwards.

First stage.—Make an incision about two and a half inches long in the line of the artery, open the deep fascia, and separate the tibialis anticus and extensor proprius hallucis muscles. This will be facilitated if an assistant flexes the foot. The muscles must be held aside with retractors.

Second stage.—If the nerve is lying on the artery it should be hooked outwards. The veins are separated if possible, and the artery cleaned, the needle being passed from without inwards.

Third stage.—Cleanse and close the wound.

Difficulties.—If an attempt is made to tie the vessel high up (Fig. 23, *a*), the operation is very difficult, owing to the depth of the wound and the impossibility of fully retracting the muscles, the bones being in the way.

Collateral circulation.—By the anastomoses between the internal malleolar with branches of the posterior tibial, the internal calcanean with the internal plantar arteries, and the external malleolar with the anterior peroneal.

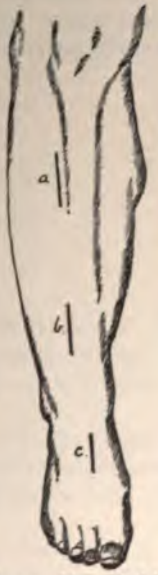

FIG. 23.—Line of incision for ligature of (*a*) the anterior tibial artery in its upper third, (*b*) lower third, and (*c*) the dorsalis pedis.

LIGATURE OF THE DORSALIS PEDIS ARTERY

Surgical line.—From midway between the two malleoli to the space between the first and second toes.

Surgical anatomy—Anterior relations.—Integument and deep fascia. Inner border of the extensor brevis digitorum muscle.

Posterior relations.—Astragalus, scaphoid, and internal cuneiform bones.

External relations.—The anterior tibial nerve and the extensor longus digitorum muscle.

Internal relations.—The tendons of the tibialis anticus and extensor longus hallucis muscles. Venæ comites accompany the artery.

Operation (Fig. 23, *c*)—**Position.**—The leg extended and the foot steadied by an assistant.

First stage.—Make an incision about an inch and a half long in the line of the vessel, between the tendons of the extensor proprius hallucis, and the extensor longus digitorum muscles. When the deep fascia has been divided, the edge of the extensor brevis digitorum is defined and drawn outwards.

Second stage.—The artery is now exposed, and the needle is passed (after separation of the veins) from the outer side.

Collateral circulation.—By the plantar arteries, and by the anastomoses between the anterior peroneal and branches of the dorsalis pedis.

CHAPTER IV

DISEASES OF THE LYMPHATIC SYSTEM

LYMPHANGITIS

Causes.—Inflammation of the lymphatic vessels is due to the spread of an infective agent which may gain an entry through a very minute wound; it may or may not be associated with lymphadenitis.

It is commonly seen in cases of poisoned wounds, in cellulitis and erysipelas, and in many other conditions. Chronic lymphangitis occurs in the vessels, proceeding from a primary syphilitic sore, and is also present in elephantiasis.

Morbid anatomy.—The vessel walls are thickened and swollen by inflammatory exudation, and the surrounding cellular tissue is infiltrated, so that the vessels can be plainly distinguished. The lymph in the interior may coagulate. In acute cases suppuration may follow and, should the deep lymphatics be affected, serious mischief may arise from suppuration in the deep cellular planes.

Signs and symptoms.—Proceeding upwards from the seat of infection towards the nearest lymphatic glands the inflamed vessels can be traced as red, swollen, tender lines, with some surrounding cellulitis which may be more evident in some parts than in others, and may completely hide the vessels. The seat of infection will be found in an unhealthy state, and in most cases pent-up pus will be present. The glands may themselves participate in the inflammation.

The swelling excited by the inflammation of the cellular tissue is increased by the obstruction to the flow of lymph along the blocked vessels. In mild cases the constitutional symptoms are but slight, and under treatment complete resolution occurs, but in the more severe the patient may have chills or a decided rigor, the temperature rises 3° or 4° F., and the general symptoms, due to the absorption of toxines, are serious. Localised or diffused suppuration may ensue either along the vessels, in the cellular tissue, in the glands, or in all these situations (see Erysipelas, chap. vii. p. 122, vol. i.).

Treatment.—The wound must be freely opened up and cleansed; the application of pure carbolic acid is to be recommended. The course of the vessels should be covered with glycerine and belladonna and hot fomentations, which must be frequently changed. If pus forms, it must be let out by free incision. The bowels should be kept open, and the patient's strength sustained by good food, stimulants, and quinine. If persistent œdema results, it may be removed by cold douching, massage, and bandaging.

LYMPHADENITIS

Causes.—Inflammation of the lymphatic glands is due to irritation by a virus, which may be carried direct to the glands without exciting inflammation of the vessels along which it passes, or these may participate.

The exciting cause of the inflammation is seated in that anatomical area the lymphatics of which are in connection with the inflamed glands, and it is in this area that the "source of irritation" must be sought. The glands of the neck may be inflamed from pediculi, sores about the head or throat, decayed teeth, scarlet fever, diphtheria, ear disease, and other causes; the glands along the saphenous vein or in the axilla are often inflamed from small sores about the foot or hand, and those of the inguinal region from venereal sores about the genitals.

Signs.—The acuteness and result of the inflammation will depend upon the virulence and pyogenic properties of the irritant causing it. Thus in syphilis the glands are but slightly enlarged, remain discrete, are chronically inflamed, and never suppurate; in cases of erysipelas, decayed teeth, and the like, although the inflammation may be acute and cause considerable swelling with pain and tenderness, and constitutional disturbance, there is not necessarily suppuration; in the mixed infection of soft chancre (see chap. ix. p. 208, vol. i.) suppuration is common, and in other cases, although the inflammation is subacute and chronic from the first, the glands may slowly break down and suppurate, or after a long time may gradually subside. In tubercular subjects glands may pass from a state of ordinary inflammation into the chronic tubercular form.

Treatment.—The first indication is to treat and remove, if possible, all local sources of irritation and infection. When the glands are acutely inflamed the local employment of glycerine and belladonna and hot fomentations is most serviceable, and may lead to resolution, provided the peripheral irritation be removed. If suppuration occurs the sooner the pus is evacuated and the cavity freely sharp-spooned the better; in some cases it is possible to dissect out the whole gland or glands, and obtain union of the wound by first intention; this should always be done if practicable.

When glands are chronically inflamed, tonics, good food, and sea-air will be beneficial, and occasionally iodide of potassium may promote absorption; but if they should resist this treatment, or should break down, they must be dissected out. The custom of applying iodine to the skin is useless and may do harm.

TUBERCULAR LYMPHADENITIS

Tuberculosis of the cervical lymphatic glands is of very common occurrence in the young, especially in the children of the poor living in large cities; the glands of the axilla and groin are much more rarely affected, but those of the thorax and abdomen usually participate in pulmonary and intestinal or peritoneal tuberculosis.

The proneness of the cervical glands to tubercular disease is dependent on the richness of the lymphatic supply, and the frequency of irritation about the mouth and throat which permits the bacillary invasion.

Morbid anatomy.—The formation of typical tubercular nodules is preceded by a general increase in the cellular elements of the gland, many of the individual cells being larger than the normal (Fig. 24, p. 96). The cells infiltrate the trabecular structure of the gland, so that the bands are not easily distinguishable. If the inflammation runs a very chronic course, there is a general increase in the fibrous capsule and meshwork of the affected gland, which is proportionately increased in density. The tubercular tissue undergoes caseation, and yellowish, softened and degenerated areas are scattered through the substance of the gland, chiefly near the centre. By coalescence of these areas the entire gland may be replaced by a softened, cheesy mass enclosed in the thickened fibrous capsule. The inflammation involves many glands which become matted together by associated periadenitis terminating in chronic suppuration. The destructive process gradually involves the surrounding structures, it implicates the skin, and when the abscess bursts, unhealthy and intractable sinuses result. In some cases, especially in the mediastinal glands, the process of caseation is succeeded by a deposition of lime salts, and the calcified gland may then remain indefinitely without causing harm.

Signs.—The situation of the glandular enlargement, the age and general constitutional bias of the patient, the chronicity and painlessness of the process, and the gradual agglutination and softening of the glands are the leading diagnostic features of this condition.

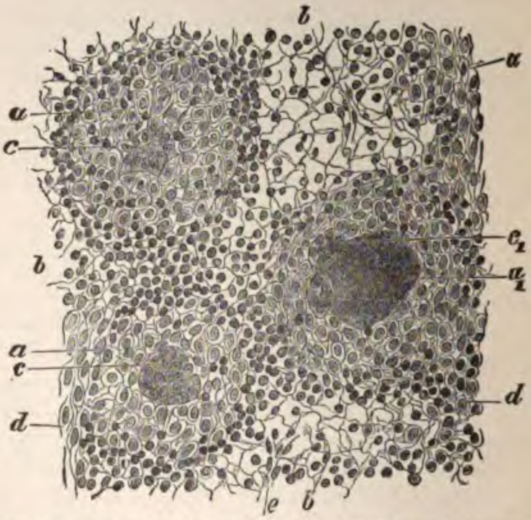

FIG. 24.—Tuberculosis of a lymphatic gland (Ziegler). *a*, fresh tubercle; a_1, caseous tubercle; *b*, lymphadenoid tissue; *c*, giant-cell in the centre of a tubercle; c_1, giant-cell at the border of a caseous focus; *d*, large-celled lymphadenoid tissue outside the tubercles; *e*, lymphoid cells.

It not infrequently happens that the enlargement of the glands varies considerably from time to time, sometimes almost, if not quite, subsiding only to reappear on some slight provocation, such as a sore throat. Complete resolution may occur, and it must remain doubtful if the glands were ever invaded by the tubercle bacillus. At first the glands behind the sterno-mastoid or beneath the jaw (those usually involved) can be felt individually enlarged, but as periadenitis is excited they form an oval mass causing considerable disfigurement, and the outlying glands may be distinctly felt.

The mass is freely movable, but this must not be taken as evidence that it does not implicate deeper structures, for the vessels and nerves may be intimately adherent and move with the glands. When softening occurs it can be readily appreciated by the touch, and as the abscess approaches the surface the skin becomes reddened, thinned, and undermined; should it burst the sinuses may continue discharging indefinitely.

Treatment.—During the early stages resolution may occur, provided all local sources of irritation are removed, and the patient be placed under the best conditions as regards food and fresh air. In the case of the cervical glands, the teeth should always receive attention. Residence at the seaside is most desirable; the place selected should be dry and bracing; Margate is highly thought of by some. Local applications are best left alone; the habit of painting iodine over the glands is, I believe, never beneficial, and may do harm. When the enlargement is obviously permanent, or when areas of softening can be felt, no time should be lost in excising the affected glands. These operations may be very tedious, are always difficult, and may lead the surgeon into a dissection requiring a good knowledge of practical anatomy. If the glands are found so adherent to the internal jugular vein that they cannot be separated, a portion of this may, after ligature above and below, be removed; I have several times had to resort to this measure and have never seen the slightest ill-result follow. The greatest care must be taken to identify every structure before it is divided, or much unnecessary damage may be inflicted. If a gland is softened, it should be gently handled so that it may be removed without rupturing the capsule. In these operations, perhaps more than any others, the surgeon will often find that as the operation progresses, he will have to considerably amplify his views as to the extent of the necessary dissection, for when the main mass of glands has been removed others can be seen or readily felt which could not be felt before the wound was made, and thus an operation, which at first promised to be easy and short, turns out to be one of great difficulty, requiring care, skill, and time. The skin wound should be carefully sutured, and if the wound be large, a small drainage tube should be introduced at the lower end for about thirty-six hours in order to drain away the serum; if the operation has been carefully performed and all hæmorrhage has been arrested, union by first intention should occur, and the dressings may remain untouched for ten days, since there is no need to dress the wound merely to remove a drainage tube. During the healing process the patient's head should rest easily on a pillow and be fixed in one position by a sand-bag, the face being turned to the sound side.

In cases where the glands are extensively broken down and adherent to important nerves and vessels, their removal by dissection is impossible. In such they should be carefully sharp-spooned and the more solid parts carefully removed by dissection and scissors; if care be taken, all the diseased tissue can be cleared away and union by first intention may be secured; undermined and thinned skin may usually be safely left, provided all diseased tissue is removed from its subcutaneous surface; such skin recovers itself in a surprising manner, but if ragged sinuses have formed, the skin surrounding their mouths should be trimmed with scissors.

LYMPHANGIECTASIS—LYMPHATIC NÆVUS—LYMPHATIC VARIX

A true lymphatic nævus is a rare condition of congenital origin. Enlargement and varicosity of the lymphatics, like a similar condition of the veins, is dependent on some cause of obstruction to the free circulation of the lymph within them; this obstruction may be caused by pressure upon the walls from without, by lymph coagula or thrombi within the vessels, or by some impediment to the circulation of the lymph through the glands. Extensive destruction or removal of the glands in the groin may cause solid œdema of the penis and scrotum, with enlargement of the lymphatic vessels. The lymphatics are thickened and dilated, and distinct varicosities and local dilatations may be present.

Macroglossia is a good example of the condition (see p. 34), and lymphatic obstruction is the most important pathological condition in elephantiasis.

A lymphatic varix forms a more or less localised swelling, with perhaps small translucent cystic dilatations, which may rupture and continue to pour out lymph (*lymphorrhœa*). The lymphatic enlargement causes œdema and subsequent induration and overgrowth of the cellular tissue.

Lymphatic varix is most usually met with about the penis and scrotum or upper part of the inner side of the thigh.

Treatment.—If the disease is quite local the mass may be excised; in other cases equable compression is the best treatment. I once caused atrophy to occur in a lymphatic nævus of the arm by excising a horse-shoe-shaped strip of the skin and subcutaneous tissue on its distal side, and thus dividing the lymphatic vessels.

CYSTIC HYGROMA

This term is applied to a cystic tumour (usually multilocular) of congenital origin, which is due to the dilatation of lymphatic spaces. The cysts are thin-walled and lined by endothelial cells similar to those met with in lymphatic vessels; they contain clear serous fluid which may be blood-stained. The cysts are intermixed with condensed and overgrown connective tissue, so that the tumour may appear to be solid.

The cystic hygroma is nearly always met with in the neck beneath the lower jaw, but may occur elsewhere, thus I have seen it on the foot and abdomen; it is sometimes associated with macroglossia. The tumour may attain a very large size, encroaching on the floor of the mouth, or growing downwards among the important structures of the neck, round which deep processes may pass, so that attempts at removal may be very hazardous. The age of the patient, the situation of the growth, and its usually multilocular cystic nature are the diagnostic features. The cysts are not very tense.

Treatment.—When situated in the neck, removal must only be undertaken if the tumour is quite small and apparently limited in extent; extensive cases, and especially those in which pressure symptoms indicate that processes are extending among the cervical structures, are not suitable for operation, although some surgeons suggest that the more readily accessible parts of the tumour should be cut away in the hope that the deeper parts will atrophy. It sometimes happens that ineffectual attempts at removal are speedily fatal from inflammatory reaction and grave general symptoms, probably due to septic material which has gained entrance, combined with imperfect drainage.

ELEPHANTIASIS ARABUM—LYMPH-SCROTUM

Etiology.—Elephantiasis occurs endemically in the West Indies, India, China, Egypt, and other parts of the world, especially along the coast-line, and in damp and swampy districts. Although the disease may occur at any age it is most common in adult life, attacks men more frequently than women, and dark races rather than white. Elephantiasis is primarily due to the *filaria sanguinis* *hominis nocturna*, and although this may not be found to be present in any given case, it is almost certain that it originated the disease, which has continued to progress after the death of the parasite. The filariæ live in the lymphatics, but it would appear that their mere presence, provided they remain alive and healthy, is not necessarily associated with any pathological changes. The ova of the filaria, passing from the lymphatics to the blood, are taken with it by a nocturnal mosquito, which dies after depositing its eggs on the surface of water, and the embryo filariæ, escaping, contaminate the water, and gain entrance to the body of the human host through the medium of unboiled, impregnated water. The filaria sanguinis hominis nocturna is, as its name expresses, found in the blood, but only at night, owing to the nocturnal habits of the mosquito which acts as the intermediary host. If the patient's habits be changed so that he turns night into day, the filaria will be found in the blood during the day and will be absent at night.

Morbid anatomy.—The gravity and situation of the effects induced by the filariæ depend upon the situation in which they lodge, and upon the degree of lymphatic obstruction which they occasion. In the thoracic duct they may cause complete obstruction, either by becoming impacted, or by exciting inflammation of the vessel walls with coagulation of the lymph and organic stricture; but if the parasites lodge in more remote parts of the lymphatic system, the pathological results will be proportionately limited and less severe.

The anatomical changes met with in elephantiasis are as follows:—The disease leads to enormous thickening of the skin and subcutaneous tissue with a great increase in the blood-vessels and lymphatics, and a general œdematous condition of the part due to an albuminous effusion. The lymphatics may be very large and form distinct cystic cavities, and the surface of the skin is sometimes beset with herpetic vesicles, which may perpetually discharge an irritating, acrid, or chylous fluid (*lymph-scrotum*, *nævoid elephantiasis*).

Chyluria may be an associated condition; lymphangitis, lymphadenitis, and lymphatic abscess are frequent, and in such abscesses the dead filariæ have been found; orchitis, epididymitis, and acute chylous hydrocele are by no means uncommon.

Symptoms.—Elephantiasis nearly always attacks the genital organs or the lower limbs (*Barbadoes leg*). With the onset of the disease the patient frequently suffers from severe pain, high fever, and marked constitutional disturbance (*elephantoid fever*), coupled locally with acute inflammation of the skin and cellular tissue, of the lymphatics and glands, and of the testes and cords. This condition may terminate in death, may subside permanently or recur at intervals; in the last case the patient's health becomes seriously undermined, and death may eventually result. In some cases these acute symptoms are all absent, the patient's general health remains good, and the gradual and characteristic enlargement is the only evidence of the disease.

The enlargement of the tissues may steadily increase until the part assumes enormous proportions, and the scrotum may weigh as much as a hundred pounds; or the disease may, especially if the patient be removed from the infected area, remain stationary, but will probably break out again should he return to it. The course of elephantiasis is very chronic and may last many years, the patient dying of some other disease. The enlarged masses of skin may ulcerate if they are exposed to irritation.

Treatment.—The preventive treatment consists in boiling the drinking water in an infected district; if a patient is already attacked, he should remove to another locality.

During the acute stage, anodynes may be necessary for the relief of pain. The surgical treatment of elephantiasis consists in the removal of all the diseased tissue. Before the operation is undertaken the scrotum should be elevated and firmly bandaged, in order that the blood may be driven out of the vessels as much as possible, and a ligature should be placed round the upper part of the tumour if practicable. The penis and testes are first exposed and isolated, and the skin is then rapidly cut away, the vessels being caught up as they are divided. No attempt must be made to fashion any flaps to cover the denuded parts, granulation will effect complete repair although some time must necessarily elapse before healing is complete. The internal administration of quinine, arsenic, and iron, and good feeding are to be recommended.

LYMPHADENOMA

Malignant Lymphoma, Lympho-Sarcoma, Hodgkin's Disease, Anæmia Lymphatica)

Lymphadenoma is a disease characterised by progressive anæmia and enlargement of the lymphatic glands. Its real nature is a matter for doubt; some regard it as a form of malignant sarcoma primarily affecting the lymphatic glands, and ultimately spreading to all lymphatic structures; it is not apparently associated with any other morbid condition. It seems probable that in cases of lymphadenoma there is some inherent tendency of the lymphatic structures to overgrow and assume malignant and tumour-like characters, such predisposition having an analogue in the hereditary predisposition to cancer. The disease is usually met with in adults, but may occur in young children (Fig. 25); it more often attacks males than females.

In some cases the enlargement of the glands may be traceable to slight and perhaps transient irritation of the peripheral lymphatics, the disease first manfesting itself as a sympathetic glandular enlargement, an enlargement, however, which continues to increase after the source of irritation has been removed.

Morbid anatomy.—The glands first enlarged are those of the neck, especially the glandulæ concatenatæ; the disease may be long limited to this region, or spread to the axillary, inguinal, mesenteric, and mediastinal glands, usually in the order mentioned.

The glands vary in consistency, according to the relative amount of cells and fibrous tissue; when the growth is rapid the glands are soft, and many localities are affected; the spleen is very liable to enlargement, as in splenic leucocythæmia, and secondary growths of lymphoid tissue are met with in the viscera and the medulla of bones.

The individual glands remain discrete for a long time, but eventually become more or less matted together; they may attain a considerable size, but practically never break down or suppurate, though they may burst their capsules; these facts are in marked contrast to the changes in tubercular lymphadenitis (see p. 95). When cut across the glands look pale, and may be spotted by extravasations, but cannot be distinguished from those enlarged by simple chronic irritation; the fibrous bands traversing the surface of section are increased in size, especially in the more slowly growing and harder glands.

Signs and Symptoms.—The gradual painless enlargement of the glands is the first sign to attract attention; they will be found freely movable on one another, and on the parts around; and although they may attain a very large size they do not inflame or suppurate. Pressure symptoms of a serious nature may be induced when the glands are growing in an important situation. If the enlargement affects various groups of glands, and especially if no source of irritation is discovered, the diagnosis is rendered the more certain. Anæmia is rapidly produced; the blood contains a marked diminution of red cells and an increase of white, more especially if the spleen is also enlarged. The anæmia causes considerable bodily exhaustion, to which the patient usually succumbs.

The temperature may rise two or three degrees, and may remain up or be remittent; in other cases it falls to and remains at the normal. The duration and progress of the disease vary much; it may remain limited to one set of glands for months, and then gradually involve the others and kill the patient by exhaustion, by pressure effects or both.

Treatment.—Arsenic, combined with iron, is the most useful drug, and as tolerance is attained, may be pushed until large doses are taken. The drug may also be administered by direct injection into the glands. All other drugs appear to be useless.

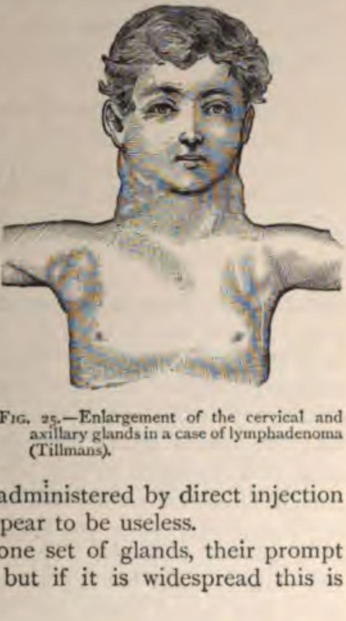

FIG. 25.—Enlargement of the cervical and axillary glands in a case of lymphadenoma (Tillmans).

When the disease is limited to one set of glands, their prompt extirpation should be undertaken; but if it is widespread this is unjustifiable.

TUMOURS OF LYMPHATIC GLANDS

All forms of sarcoma may secondarily affect the lymphatic glands. The probable identity of lymphadenoma with primary sarcoma of lymphatic glands has been referred to above.

Cancer affects the glands in immediate anatomical relation with the primary growth.

Malignant tumours of glands may attain a very large size, implicate important structures, involve the skin and fungate on the surface, and may break down and give rise to abscess.

The treatment consists in removal when the glands are not too large or too deeply fixed. In cases of cancer it is advisable in some cases, *e.g.* the breast, to clear away all the glands, whether they can be felt to be enlarged or not (as in cancer of the breast), at the time of removal of the primary growth.

CHAPTER V

DISEASES OF BONE

Anatomy.—Bone is composed of animal and earthy matter in the proportion of one to two; the former consists of gelatine, the latter mainly of phosphate of lime or "bone-earth." The difference between compact and cancellous bone is merely one of density of structure; in the former the bony lamellæ are thick and numerous, and the spaces small, whereas in cancellous bone the spaces are large and separated by thin spicules and plates of bone. The compact tissue forms a complete shell for the bone; it becomes thinner as the articular end is reached, and at the joint-surface is surmounted by a layer of cartilage. The cancellous tissue is most abundant in the ends of long bones; it completely fills up the interior of flat, short, and mixed bones, but in long ones the centre of the shaft is occupied by the medullary canal surrounded by cancellous bone.

The medullary canal contains yellow marrow, but in the ends of long bones and in cancellous tissue generally the marrow is of the red variety. The medullary canal and Haversian spaces are lined with a delicate, highly vascular layer of areolar tissue, with osteoblastic cells similar to those met with in the periosteum.

The periosteum closely invests the compact tissue, except at the cartilage-covered ends, and consists of two layers; the outer is composed of white fibrous tissue; the inner of elastic tissue and, next to the bone, of a layer of pyriform osteoblasts, which in adult life become flattened, but on irritation resume their pyriform shape and bone-forming properties. In young bones the periosteum is specially adherent to the epiphysary cartilage.

The blood supply of the outer thickness of the bone comes from the periosteal vessels, which communicate with the branches of the medullary artery destined for the supply of the cancellous tissue and marrow; but in spite of this communication, true collateral circulation is very imperfect. The arteries open into numerous, large, thin-walled, and valveless veins, which are very likely to be the seat of thrombosis in infective inflammations of bone. The blood-vessels are accompanied by perivascular lymphatics; nerves are supplied through the periosteum, and also accompany the medullary artery.

In the young the epiphyses are separated from the diaphysis by a layer of ossifying cartilage—the epiphysary line. Disease or damage of this part may seriously affect the growth of the bone, and should the epiphysary line lie within the capsule of the joint, may be the starting-point of destructive arthritis (see p. 132).

ATROPHY OF BONE

Atrophy of bone may occur as a senile change or in consequence of disuse from muscular paralysis, joint disease, old dislocation, or more general causes. In some unexplained cases there is a condition of general atrophy and brittleness of the bones, and as a consequence multiple fractures from very slight causes are common (*fragilitas ossium*). Such a condition is sometimes seen in congenital syphilis.

Atrophied bones are lighter and more porous than natural, but usually retain their shape and size. The cancellous spaces are much larger than normal, and the compact bone may be reduced to a mere shell; the medullary canal is widened. Atrophied bones as a rule readily unite when broken.

The surgical importance of atrophy lies in the diminished strength of the bone, which is unable to bear any rough manipulation such as may be necessary in the attempted reduction of an old dislocation. Atrophy must be distinguished from arrest of growth, which may be due to injury or disease of the epiphysary line or neighbouring joint, or may be part of general dwarfing of the body.

HYPERTROPHY OF BONE

Simple overgrowth of bone occurs in response to increased need for additional strength, as in great muscular development. Clinically, bones are sometimes said to be hypertrophied when they are enlarged as the result of some inflammatory condition, but this use of the term is incorrect.

RICKETS

Rickets is a general disease, the main stress of which falls upon the epiphysary lines of the bones.

Etiology.—The disease is dependent upon dietetic errors, coupled with impure and insufficient air and general defective hygienic conditions; it is consequently almost confined to the children of the poor, especially those living in crowded towns. Children brought up by hand and fed on starchy and improper artificial foods are specially liable to become rachitic. Rickets usually manifests itself during the first year of life and very rarely after the third, but cases have been met with in which the disease has occurred as late as the ninth year (*late rickets*).

Ill-health in the parents may induce a tendency to rickets in the offspring, who under such circumstances are often naturally puny and feeble. There is practically no evidence to support the supposition that rickets is allied to congenital syphilis, or that tubercle is an etiological factor in any other way than by depreciating the health of the mother during her pregnancy, and so impairing the vital powers of her offspring.

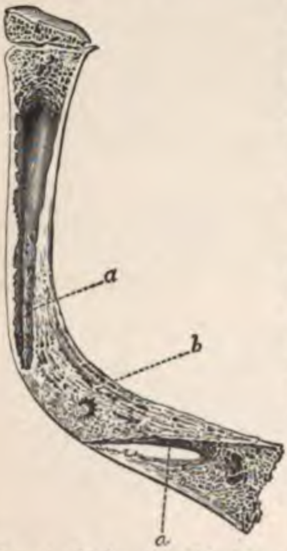

FIG. 26.—Section of a tibia from a case of rickets. The medullary canal (*a*) is interrupted, displaced, and filled up by the formation of new bone (*b*) in the concavity of the bend (Follin, after Beylard).

Morbid anatomy.—The morbid changes met with are mainly confined to the osseous system, especially at the epiphysary lines. The proliferating zone at the line of ossification is irregular, soft, vascular, and considerably increased in thickness, so that the bone ends are characteristically enlarged. The changes preparatory to ossification are irregular and extensive, but little or no new bone is formed, although islets of it may be found in the proliferating zone. Beneath the thickened and vascular periosteum there is a thick layer of soft new tissue, especially in the concavity of a bend (Fig. 26); but no true ossification takes place so long as the disease is in progress. In flat bones this new tissue causes considerable thickening, in long ones it increases their diameter.

The bone which was already formed before the onset of the disease does not undergo any change, but in the long bones it becomes more or less absorbed as the medullary canal is formed internally, and hence, the new tissue beneath the periosteum being unstable, there is marked loss of strength, and the bones yield in the direction of greatest pressure, producing the distortions to be presently described. Occasionally greenstick fracture may occur.

In bad cases of rickets the liver and spleen may be enlarged, and in general appearance resemble albuminoid organs; microscopic examination shows that they are the seat of fibroid overgrowth; it is uncertain whether these changes should be regarded as distinctly rachitic.

Symptoms.—Before the characteristic osseous changes are apparent, the child exhibits symptoms of digestive inadequacy. There is vomiting, diarrhœa, and flatulent dyspepsia, and the abdomen is enlarged and protuberant. The child is drowsy, dull, apathetic, and listless, preferring to be left alone, and often crying when touched, apparently owing to cutaneous hyperæsthesia and tenderness of the bones, perhaps also to a feeling of weakness and incapacity for exertion. At night he sweats about the head and neck, is notably restless and kicks the clothes off; this, combined with a special tendency to catch cold, may lead to serious bronchial mischief to which many rachitic children succumb.

The child is anæmic, muscularly feeble, and the skin is often loose and wrinkled; the fleshy parts have "lost tone."

As soon as the disease is established the epiphysary ends become enlarged, nodular, and tender, and hence the joints look large—an appearance increased by the muscular wasting—the flat bones are thickened. The soft and yielding bones tend to bend in the direction of greatest pressure, the curvature being usually an exaggeration of that normal to the bone, but the deformity depends in great measure upon the age of the child, whether he is nursed, can crawl, or is able to assume the erect posture. In these respects rachitic children are naturally backward.

The head.—The calvaria is abnormally large as compared with the face and is elongated antero-posteriorly; the fontanelles remain widely open and close late; the forehead is square and bossed, and the bones are thickened.

Craniotabes and Parrot's bossing may both be present (see chap. ix. p. 203, vol. i.).

The teeth.—Dentition is delayed and irregular, and the teeth, being deficient in enamel and density, are liable to crumble and early decay.

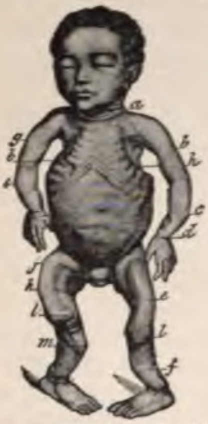

FIG. 27.—The chief deformities of the skeleton met with in cases of rickets. The letters indicate the chief points to be observed (Follin, after Beylard).

The spine.—Owing to the muscular and ligamentous weakness and the spongy state of the bones, the spinal column becomes curved antero-posteriorly from above down; it forms one long curve, in marked contrast to the limited curvature of caries. The curvature disappears when the child is held up. Lateral curvature is sometimes seen (see Cyphosis, chap. xii. p. 271, vol. i.).

The thorax (Fig. 27).—At the costo-chondral junction there is marked "beading," the enlargement being, however, most marked on the pleural aspect. Usually just external to the beading, but sometimes along or in front of this line, there is a depression of the ribs running downwards to about the end of the seventh; it then passes outwards, so that the diaphragm is pushed downwards, and the abdomen is rendered more protuberant. The chest is thus flattened laterally, but its anterior posterior measurement is increased; the capacity is diminished, and hence lung disease, which is unfortunately common in the rachitic, is especially serious.

The pelvis is small and flattened in the conjugate diameter, owing to the projection of the sacral promontory, but it is broadened transversely. The ilia are turned outwards, the arch of the pubes is widened, and the tuber ischii are separated. In consequence of these changes the whole pelvis is shallow, the brim contracted and kidney-shaped, but the outlet is widened. These changes are chiefly due to the superincumbent weight of the trunk. The acetabula are rarely driven inwards, since the changes occur before the child is able to walk. Sometimes the outlet is narrowed owing to the tuber ischii being approximated in consequence of the child being nursed in the sitting position on the attendant's arm. In females the pelvic changes may, in after life, cause serious trouble during parturition.

The upper limbs (Fig. 27).—If the child can only crawl, and is allowed to do so, the upper limbs become much deformed; the forearm bones are bent with the concavity to the flexor aspect, and the humerus often shows a similar bend at the attachment of the deltoid, the concavity being inwards; the clavicles may be bent at a right angle.

The lower limbs (Figs. 27, 28).—In children who can only crawl the femora are more bent than the leg bones, their antero-posterior curve is increased, and there is a similar curvature in the lower half of the tibia and fibula. If the child can walk, the legs may be additionally bowed, or the ankles may give way, causing consecutive flat-foot and genu-valgum. Genu-valgum may also be due to a bending of the limb at the knee joint, the leg going in an outward direction.

In consequence of the general feebleness and instability of the osseous system, rachitic children walk late; and the changes at the epiphysary lines and deformity of the bones leave them stunted, ill-developed, ungainly, and awkward.

Prognosis.—Under appropriate feeding and improved hygienic surroundings the disease gradually subsides, and may be quite cured in a few months. Some of the deformity and enlargement of the epiphyses may disappear, but some is permanent. As the disease subsides the bones ossify and become dense. Death from uncomplicated rickets is extremely rare. Rachitic children are very liable to bronchitis, broncho-pneumonia, laryngismus stridulus, convulsions, and intestinal catarrh, any of which may prove fatal.

Treatment.—Rickets is a preventable disease, and is becoming less common as the social surroundings of the poor in our large cities is being improved. Rickety children should be given plenty of fresh air but must be warmly clad with flannel next the skin, and must be guarded against cold, on account of the serious danger of lung mischief. At night the child should be clad in flannel combinations with sock extensions, so that he does not remain quite uncovered should he kick off the bed-clothes. The action of the skin must be encouraged by tepid bathing and cold sponging, and the nutrition of the muscles increased by gentle massage and friction.

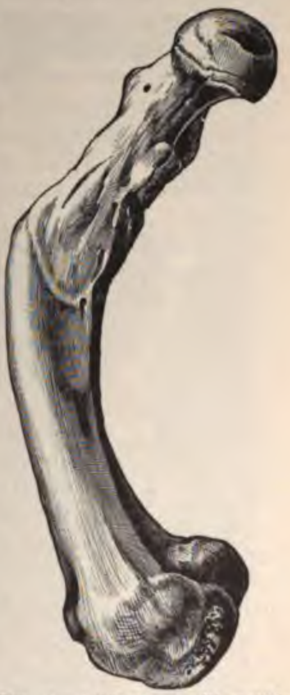

FIG. 28.—Adult's femur with rachitic curvature of the diaphysis (Ziegler), (one-third of the natural size).

Diet.—If the mother cannot suckle the child, or if her milk is insufficient for its needs, it must be carefully brought up by hand. Cow's milk (which may be sterilised before use), or condensed milk, may be given. A wet nurse is still better, but unfortunately is out of the reach of the parents of most rickety children. Ass's milk is recommended by some. If the milk disagrees with the child, it may be given with lime water, or be more freely diluted. If there is continued diarrhœa, milk should be withheld and some artificial food tried. As regards artificial foods, great care should be taken in their selection and use. Mellin's, Nestle's, and Savory and Moore's are the best; the first is somewhat constipating, the last contains a good deal of malt, and is laxative. A child should be weaned gradually at about the eighth month; but weaning should not be begun if he is ill. During weaning a little farinaceous food may be given, and very soon beef-tea, chicken-, veal-, or mutton-broth. As soon as meat is allowed, it must be finely minced or pounded, since the teeth are not strong enough to perform their office satisfactorily. Raw meat is decidedly beneficial, especially if gastro-intestinal irritation is marked. It is best prepared by scraping a piece of steak and mixing it with bread crumbs and a little sugar, or the meat may be pounded up and the juice given with bread crumbs. Rickety children should not be given much starchy food or fats, but they should be allowed green vegetables or the juice of an orange or lemon, or such fruit as may be obtainable, provided it does not excite diarrhœa.

Medicinal.—Preparations of maltine, maltine and peptones, or maltine-beef-and-iron are nutritive and tonic, and are usually well borne by rachitic children. Cod-liver oil and the syrup of the phosphate of iron, steel wine, and sometimes small doses of quinine are good. Cod-liver oil must be given in quite small doses to begin with, and as the child becomes accustomed to it the dose should be increased. If the oil disagrees, maltine or glycerine are good substitutes. These preparations should be given directly after food, when digestion is in progress.

Mechanical measures.—Splints usually do more harm than good when they are used to correct deformity; but for children who can walk, a splint reaching below the foot may be placed on each leg, so as to prevent its standing up. The deformities of the long bones must be, as far as possible, prevented by keeping the child at rest, and so avoiding pressure. Bones already bent may be gently manipulated by the mother, so that further bending is prevented and the amount already present diminished. Rough handling is, of course, to be avoided, or greenstick fracture may result. Permanent deformity may be treated by operation when the disease is arrested, and the child's health is good.

INFANTILE SCURVY—ACUTE OR SCURVY RICKETS

This acute disease is usually met with in children between six and eighteen months of age, and is dependent upon an insufficient diet. It practically only occurs in children brought up by hand. It is said that when sterilised milk is alone used to feed the child, that infantile scurvy is especially liable to arise.

Morbid anatomy.—Scurvy is the essential, and rickets a variable element, it being sometimes almost inappreciable (Barlow). The lower limbs, especially the femora, are most usually affected; but many bones may suffer simultaneously or consecutively, and the condition is often symmetrical. The changes may involve more or less of the shaft, but are specially prone to attack the epiphysary ends. The periosteum is thickened, and extensive hæmorrhages occur beneath it, and also sometimes along the epiphysary line, so that the epiphysis is separated. Fractures sometimes occur if the rickets is marked (Fig. 29). Hæmorrhages into the muscles, from mucous membranes, beneath the skin, and from the gums are common.

Symptoms.—For some weeks before the nature of the disease is apparent, the child may be quiet, listless, or fretful, and apparently in pain. The bone lesions come on suddenly: there is rapid and great swelling of the limb at the seat of disease, the skin is tense, shiny, and rather hot, and there is some œdema, which masks the subperiosteal swelling; this will, however, become apparent in a

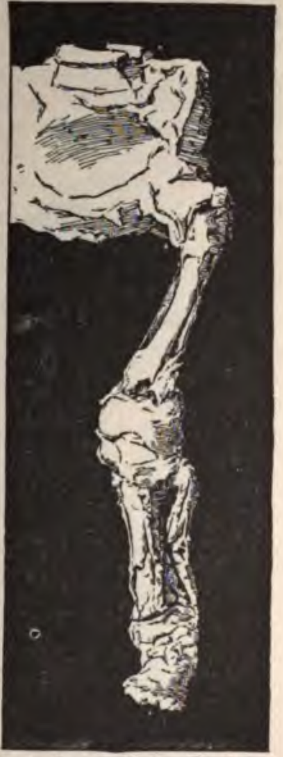

FIG. 29.—Scurvy rickets. The femur and leg bones are stripped of periosteum beneath which is blood clot. The upper epiphysis of the femur is separated and the bone is broken just above the lower. The knee joint is healthy. The periosteum and epiphyses are separated from the leg bones, and there is a comminuted fracture about the middle. The other limb is in a similar state and is preserved in the specimen (Westminster Hospital Museum, No. 19. Drawn by C. H. Freeman).

few days, as the œdema subsides. There is continuous severe pain, much aggravated by movement, and consequently the limbs lie quite motionless and appear as if paralysed. If the epiphyses are separated, there is dull crepitus on movement. The temperature is usually raised to 102° or 103° F., and there is marked muscular feebleness, with prostration and anæmia; the last is intensified by the hæmorrhages. The gums are spongy, sloughy, tender, and bleed readily when touched.

Purpuric spots may appear in the skin, and occasionally sloughy ulcers are present. Intestinal disturbance and diarrhœa are often met with. The urine may be albuminous or bloody, and contains uric acid in excess. The signs of ordinary rickets are present, but may be very slightly marked.

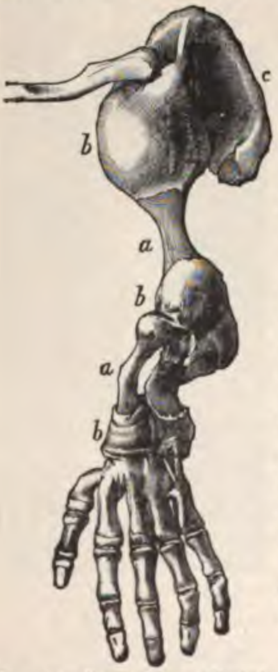

FIG. 30.—Fœtal rickets (Ziegler). *a*, diaphysis; *b*, *b*, *b*, epiphyses of the humerus and forearm bones; *c*, scapula (four-fifths of natural size).

Prognosis.—Under appropriate treatment these cases usually quickly recover, but death may be due to exhaustion or lung mischief. The disease runs its course in about two or three months. The subperiosteal hæmorrhage becomes absorbed and the bone is restored to its normal outline.

Treatment.—Antiscorbutic remedies are essential. The diet must consist of milk, minced raw meat, or meat juice (made by pounding meat in a mortar), fresh green vegetables and fruit. Maltine and iron, cod-liver oil and syrup of iron may be advantageously given if they do not upset the digestion. As soon as the acute symptoms have subsided the child should be taken into the fresh air as much as possible, but during the acute stage the affected limbs must be kept at rest, and cold should be applied to the seat of hæmorrhage.

FŒTAL RICKETS—FŒTAL CRETINISM

Occasionally certain congenital osseous changes are observed which differ considerably from ordinary rickets, and it is at present doubtful whether these cases should be regarded as due to rickets or cretinism, the patients exhibiting the general characteristics of the latter state. The cells in the zone of proliferating cartilage are large, round, and not arranged in columns; moreover, the process affects the whole epiphysis and not merely the epiphysary line as in ordinary rickets. The bone is stunted and the epiphyses are much enlarged; the whole being dense and thick. Between the epiphysis and diaphysis, and growing up round the former in a cup-shaped manner, is a growth of fibrous tissue developed from the periosteum. In some cases early synostosis of the basilar sutures has been noted. These children are frequently born dead.

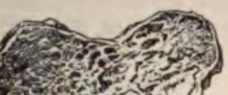

FIG. 31.—Longitudinal section of a femur affected by osteomalacia. Nearly all the bony tissue has disappeared and the femur has undergone remarkable distortion. The interior contains cystic spaces containing adipocere-like material (Westminster Hospital Museum, No. 22. Drawn by C. H. Freeman).

OSTEOMALACIA OR MOLLITIES OSSIUM

Etiology. — Osteomalacia is much more common in the poor than the rich, in women than men, and usually affects the pregnant and those who have borne large families. The actual cause of the disease is unknown. Osteomalacia is a rare disease in this country, but is comparatively common in some parts of Germany.

Morbid anatomy.—The disease consists essentially in decalcification of the bones, accompanied by fatty degeneration of, and hæmorrhage into, the animal matter. The pelvis, spine, and chest are first and chiefly affected, but the disease may spread to the long bones and become almost universal. The decalcification gradually spreads throughout the bone, the compact tissue (with the exception of a thin layer externally which persists) being reduced to the condition of cancellous, the spaces of which are widened. The periosteum remains unaltered. The bone is filled by an oily, fatty matter, often mixed with extravasated blood, and resembling splenic pulp; microscopically this material contains blood cells, fatty and granular débris, and numerous small cells of indefinite shape. The decalcified and softened bones may be readily cut with a knife; yielding to pressure they become much distorted or fractured, there being a greater tendency to bending than to fracture (Fig. 31, p. 113). In consequence of this the spine becomes curved, the chest misshapen, and its capacity diminished; the pelvis assumes the trifoliate character, the femoral heads and acetabular cavities being approximated, the pubes pushed forward, and the ilia flattened. This often causes considerable difficulty in parturition, which may necessitate cephalotripsy or Cæsarean section. The bones of the limbs similarly yield to pressure, and in severe cases the want of stability of the skeleton is such that the patient is quite unable to stand or sit, being completely powerless, and the muscles through inactivity undergo fatty atrophy.

Symptoms.—The disease is very insidious in its onset and progress, and may be aggravated by the occurrence of pregnancy, possibly on account of the demand for earthy salts for the formation of the fœtal skeleton. At first the patient complains of general rheumatic pains, which become worse at night, and the real nature of the disease is frequently unsuspected until the characteristic changes in the bones remove all doubt. The temperature and bodily functions are normal; the urine is often abundant, pale in colour, and contains a large amount of phosphate of lime. In course of time the patient loses health and flesh, becomes enfeebled and, if the chest be affected, suffers from bronchial and pulmonary attacks which may prove fatal; or death occurs from exhaustion or some other disease. The duration varies with circumstances, and the fatal termination may not result for six or eight years. Recovery sometimes occurs, though rarely so; the distortion of the bones is permanent.

Treatment.—No curative measures are known. The general health should be kept up and means taken to prevent distortion. Should pregnancy unfortunately occur (and the patient should be warned of its danger), the induction of premature labour may be necessary. In view of the association of mollities with pregnancy and the child-bearing period of life, oöphorectomy has been proposed and practised, and in bad cases may be properly undertaken.

ACROMEGALY

Etiology.—This rare disease occurs more often in women than men, and usually during the third or fourth decades of life. No causative factor is known, but atrophy, and more rarely hypertrophy, of the thyroid, or persistence of the thymus, or notably enlargement of the pituitary body, may be associated conditions, although their relation is unknown.

Morbid anatomy.—Acromegaly especially affects the bones of the hands and feet, the lower jaw, and certain parts of the face, and in bad cases spreads upwards to the long bones of the limbs. The bones are simply enlarged and the soft structures proportionately so, giving the part a merely hypertrophied appearance; the skin is unaffected.

The physiognomy is characteristic: the lower jaw is much increased in size, the chin projects, the teeth protrude and are separated, and the superciliary ridges are very pronounced, giving a scowling look to the face. The size of the lower jaw gives the whole face an egg-shape, the larger end being downwards. The features are coarse and gross. Sometimes the upper jaw, nasal bones, and skull are also enlarged.

Symptoms.—The onset is very insidious and the disease may steadily progress for many years. The patient complains of general rheumatic pains, and often of persistent or repeated headache. There may be amenorrhœa. Optic neuritis and blindness sometimes occur in cases in which the pituitary body is sufficiently enlarged to cause pressure on the optic commissure. The real diagnosis of the disease depends upon a recognition of the bony enlargement—a discovery often made by the patient's friends, who notice the alteration in her face. After a time the general health may suffer, but as a rule there are but few indications of importance.

Treatment.—The rheumatic pains and headache must be treated on ordinary principles. No curative measures are known.

HYPEROSTOSIS—LEONTIASIS OSSEA

This rare condition, usually beginning in early life and pursuing a prolonged course over many years, is apparently of the nature of periostitis.

It chiefly affects the cranial and facial bones, which become enormously thickened and enlarged by new porous bone; this may in the course of time become dense. The new bone fills up the antrum and various cavities, causes great deformity, and leads to pressure effects on the eye, nose, brain, etc., according to the actual seat of the disease. After many years, death may ensue from gradual encroachment on the brain. The disease is usually bilateral. No treatment is of any avail, but if the condition is unilateral, or affects one side more than another, pressure effects may render operative interference necessary and justifiable.

OSTEITIS DEFORMANS

Etiology.—Osteitis deformans is a rare disease, attacking the sexes equally during advanced age. No cause is known. In many cases sarcoma or cancer has been associated, but there is no evidence to prove that this is more than coincidence. Rheumatism and syphilis are not recognised as etiological factors. The disease is very insidious, and may steadily progress for many years without apparently affecting the general health.

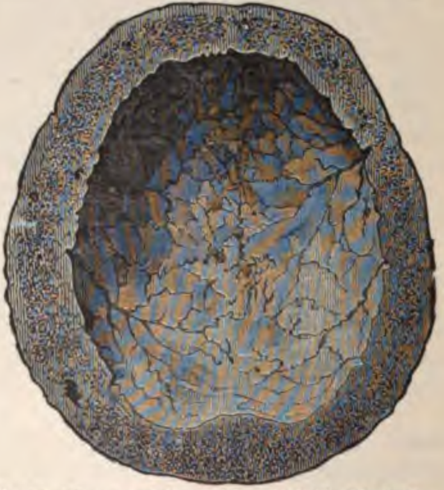

FIG. 32.—Osteitis deformans of the cranial vault (Follin, Musée Dupuytren).

Morbid anatomy.—The disease is inflammatory. The affected bones are much increased in size and thickness, the compact tissue is reduced to the condition of cancellous, and the whole bone has a spongy, pumice-stone-like appearance (*spongy hypertrophy*). In the early stages the bones are weaker than natural, and hence incline to bend in the direction of greatest pressure; later on the density and strength are increased. The limb bones are sometimes actually elongated, but this is more than counterbalanced by the bending. The calvaria is first affected, and the onset of the disease is often recognised by the fact that the patient's hats become too small for him. The face usually escapes, so that by remaining its normal size it offers a marked contrast to the calvaria. The skull is much increased in size, and the forehead squared; the face is egg-shaped, its larger end being upwards—the opposite to what obtains in acromegaly. The long bones are affected from the trunk towards the periphery, and as the lower limb bones yield there is some shortening of stature, and the gait becomes slow and shambling. For the same reason, added to curvature of the spine, the patient assumes a characteristic posture, bending forwards in an apparently helpless manner. The deformity of the chest may occasion some respiratory difficulty, with a tendency to bronchial catarrh, which is liable to last a long time.

Symptoms.—General rheumatic pains are common, but apart from this the general health remains good, and the patient dies of some intercurrent mischief.

Treatment is of no avail.

INFLAMMATION OF BONE

Inflammatory affections of bone may originate in the periosteum, medulla, cancellous or compact tissue, or in the epiphysary line or centre; the process, however, never remains limited to the seat of its origin, but spreads to other parts, so that various changes are associated. Thus, necrosis is always accompanied by caries, and the chronic irritation produced leads to osteoplastic periostitis; similarly, osteomyelitis may occasion necrosis of the central portions of the bone, the dead part being surrounded by a carious area, with which is associated osteoplastic osteitis and periostitis. The actual process of inflammation does not differ from that occurring in soft structures. The animal part of the bone is alone capable of undergoing any vital change, the earthy salts being simply removed by some chemical process not fully understood; this decalcification always takes place in the presence of certain large multinucleated cells known as osteoclasts; it has been suggested (though certainly not proved) that an excess of lactic acid acting on the lime salts gives rise to a soluble lactate of lime which is excreted by the urine.

Inflammatory affections of bone may be due to injury or some acute infective process, but in most cases syphilis or tubercle is the causative agent.

INFLAMMATION OF THE PERIOSTEUM

ACUTE LOCALISED PERIOSTITIS

Etiology.—Acute local periostitis may be due to injury, cold, rheumatism, gout, secondary or tertiary syphilis, or to one of the acute specific diseases.

Morbid anatomy and results.—The inflammatory exudation infiltrates and thickens the periosteum and the cellular tissue external to it, and accumulating beneath it, strips the congested membrane from the bone. The separation is quite local, and the process does not tend to spread. In the majority of cases the inflammation subsides, the effusion becomes absorbed, and the only trace of the mischief is some slight thickening from periosteal new bone.

If suppuration occurs, the pus perforates the periosteum, passes along the cellular planes, and ultimately bursts externally, sometimes at a considerable distance from the primary seat of mischief. In most cases the abscess heals without bad results, but occasionally the outer layer of the bone, deprived of the periosteal blood supply, exfoliates.

Signs and symptoms.—The local signs are best observed in a superficially seated bone, such as the tibia, which is frequently the seat of the disease. There is a local, tense, acutely tender swelling due to the effusion beneath the periosteum. The skin is red and œdematous, especially if suppuration occurs. There is great pain of a gnawing, aching character like toothache, which is worse at night. The pain is often most intense at one spot, and is readily brought out by percussion. Constitutional disturbance is usually slight the temperature not often rising above 102° F., but should suppuration occur the fever and local signs are aggravated.

Treatment.—If the inflammation is not severe, complete rest of the part in the elevated position, combined with hot fomentations, may be the only local treatment necessary. Leeches may be used if the pain is very great. In more severe cases no time should be lost in relieving tension by a free incision down to the bone, and if the pain is severe this should also be sawn into (*linear osteotomy*). This treatment may avert threatened suppuration, and is at once followed by great relief and speedy repair. If suppuration has occurred, the pus must be evacuated under strict antiseptic precautions. Should superficial necrosis ensue, the treatment must be that given at p. 136. As regards the general treatment, little is needed but the regulation of the bowels by saline purgatives; during the febrile stage the diet must be restricted to slops.

ACUTE DIFFUSE INFECTIVE PERIOSTITIS—ACUTE NECROSIS

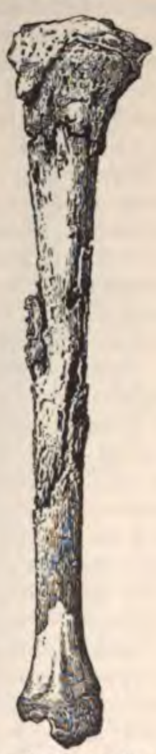

Fig. 33.—Acute necrosis of the right tibia of a young patient. The bone is broken at the upper end where the sequestrum was separating. The still living bone is covered by porous bone from the periosteum (Westminster Hospital Museum, No. 206. Drawn by C. H. Freeman).

Acute necrosis is the name given to an acute infective inflammation of growing bones usually beginning in the deeper layers of the periosteum, but in some cases in the epiphysary line (*epiphysitis*), or in the medulla (*osteomyelitis*).

Etiology.—Acute necrosis is essentially a disease of early life, and is dependent on the presence of pyogenic organisms, notably the staphylococcus pyogenes aureus. It may (especially in weakly children) follow some slight injury, or may complicate, or have been preceded by, one of the acute exanthemata. As regards the influence of injury, Becker has shown that organisms injected into healthy rabbits did not cause acute necrosis; but if the bones were previously contused or broken, the disease was occasioned. Though usually attacking one of the long bones, especially the tibia or femur, no bone is exempt, and sometimes many are simultaneously or consecutively affected.

Morbid anatomy.—Whether the inflammation originates in the periosteum, epiphysary line or medulla, the general progress of the case is the same. The course is rapid; suppuration speedily occurs, and the bone, deprived of its blood supply, dies. In many cases osteophlebitis, followed by general embolic pyæmia, proves fatal. Beginning as a periostitis, the membrane is separated from the bone by the purulent exudation, which extends widely, and completely denudes the diaphysis; on reaching the epiphysary line the destructive inflammation may spread along it so that the diaphysis is separated (Fig. 33), and finally the medulla participates, so that in many cases all parts of the bone are involved. The thin-walled veins inflame, and the infective thrombi disintegrate, and being carried to distant parts, excite secondary centres of inflammation. Fortunately all cases do not run the above-described course; the periosteum may be widely separated, but further spread is arrested under appropriate treatment, and the patient ultimately recovers, sometimes without any actual necrosis of bone. Should necrosis occur its extent varies. The periosteum throws out new bone which locks in the sequestrum, but is perforated by cloacæ for the discharge of pus, which continues until the foreign body is removed (see Necrosis, p. 133, and Fig. 44, p. 134).

Signs and symptoms.—The onset is sudden, and is accompanied by shivering or convulsions, and a rapid rise of temperature, which may reach 104° or 105° F. If the case progresses to a fatal termination the constitutional disturbance deepens. Typhoid symptoms set in, and there may be evidence of secondary involvement of the lungs, etc., as in other cases of acute septic infection. Locally there is great swelling, probably involving nearly the whole length of the diaphysis, which may be completely separated from the epiphysis. The superficial structures are red and œdematous, and there is evidence of fluctuation, or at least of elasticity, for if the bone be deeply seated (*e.g.* femur), the detection of fluctuation may be very difficult. Sometimes the process extends to the neighbouring joint. Acute necrosis may be mistaken for acute rheumatism; the fact that the lesion is usually single, and that the shaft of the bone and not the joint is the seat of the affection, and the rapid onset of œdema followed by suppuration, will usually avoid such a mistake.

Treatment.—A free incision must be at once made down to the bone; the abscess cavity should be examined with the finger to ascertain to what extent the periosteum has been stripped up, and whether counter-openings are necessary. It by no means follows that because the bone is denuded it will necessarily die, for, as already stated, necrosis is not constantly met with. The abscess cavity should be flushed with antiseptic lotion, freely drained and carefully dressed, the dressings being removed as often as the amount of discharge necessitates. If with free drainage the general condition does not improve, the medullary cavity should be freely opened with a view to evacuate septic material which may be confined within it. If necrosis occurs, the treatment for that condition must be adopted. Should the diaphysis be found completely separated and lying in a large abscess cavity, it is better left alone for some time, since it acts as a splint, and its presence serves as a stimulus to the periosteum which throws out new bone to replace the dead shaft, when this is sufficiently strong to maintain the length of the limb the sequestrum should be removed. In the case of the fore-arm or leg, where there are two bones, a dead shaft may be removed at once, for the intact bone will maintain the normal length of the limb.

If a joint should be affected, amputation is usually necessary, but as a rule the operation should not be performed until the acute mischief has subsided and the patient's general condition is much improved; if, however, in spite of the above-mentioned treatment no improvement occurs, immediate amputation is imperative, provided the patient is not suffering from acute septic infection.

As regards constitutional treatment it is necessary to keep the bowels acting, to give plenty of easily digestible food, and stimulants if the pulse is weak. Quinine and bark, and during convalescence, iron and cod-liver oil, should be administered.

CHRONIC OSTEOPLASTIC PERIOSTITIS

Etiology.—Chronic periostitis is usually dependent upon long-continued irritation due to disease of the bone or neighbouring joint, or to chronic inflammation of the soft tissues, as is often seen in chronic ulceration of the leg (Fig. 34). It may also be due to injury, cold, gout, rheumatism, or syphilis.

Morbid anatomy.—Chronic periostitis leads to thickening of the membrane, and the formation of new bone beneath it; when this is quite localised the resulting enlargement is known as a node. The new bone is at first finely porous and spongy, but later on becomes dense, hard, and smooth. It is deposited in the form of spicules, nodules, and irregular plates or laminæ which are parallel with the long axis of the bone. The

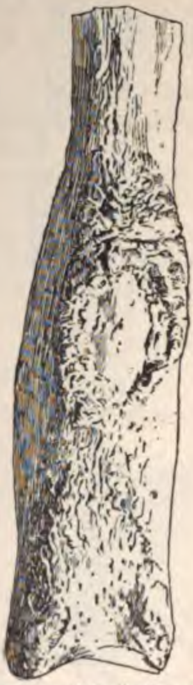
FIG. 34.—Osteoplastic periostitis of the tibia. In the centre is a smooth area which formed the floor of an ulcer; round this the new bone forms definite nodules (Westminster Hospital Museum, No. 155. Drawn by C. H. Freeman).

new bone is often especially abundant at the points of attachment of muscles, tendons, or ligamentous structures, and along the natural ridges of the bone; it is deeply grooved by channels in which run the blood-vessels. If the change is due to quite local causes, it will itself be local, but if consecutive to widespread disease of the bone or some general condition, *e.g.* syphilis, it may affect the whole bone, which is consequently much enlarged. Chronic osteitis is usually an associated condition (Fig. 35).

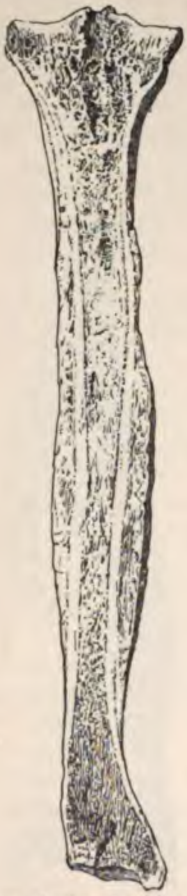

FIG. 35.—Section of a tibia affected by chronic osteitis and periostitis. Dense new bone is present on the outer surface of the shaft and also obliterates the medullary canal (Westminster Hospital Museum, No. 175. Drawn by C. H. Freeman).

Signs.—The enlargement of the bone is quite obvious. The patient complains of severe, deep-seated, gnawing pain, which is much worse at night, and in damp, cold weather. The pain is increased by percussion, often radiates, and is but little benefited by ordinary measures.

Treatment.—All sources of irritation must, if possible, be removed. Iodide of potassium may alleviate the pain, but its effect is often soon lost.

If the condition is quite local and the severity of the suffering justifies it, an incision may be made through the periosteum, and the bone may be cut into with a saw (*linear osteotomy*), or a wide gutter may be cut in it with a chisel; by this means tension is relieved and the pain is often cured.

EXPANSION OF BONE

This term has been applied to an increase in the size of a bone from osteoplastic periostitis, accompanied by destruction of its interior, due either to the growth of a tumour or to suppurative caries, the irritation of which causes the chronic periostitis. If the process of destruction is more rapid than that producing the new bone, this will eventually be perforated and the pus or new growth escape into the surrounding soft structures (see pp. 127 and 139).

CHRONIC OSTEOPLASTIC OSTEITIS

The causes of this condition are the same as those of chronic periostitis, with which it is associated.

The organisation of the inflammatory products leads to condensation of the area affected, which may become as dense and hard as ivory. The cancellous spaces are very much narrowed or obliterated, and the process extending to the medullary canal, the whole bone may be rendered solid, so that it is much increased in weight (Fig. 35).

It is also increased in size by the deposit of new bone from the periosteum. In extreme cases the consolidation is so great that the vascular supply is quite inadequate and the bone dies.

Signs.—The signs of chronic osteitis are identical with those of chronic periostitis, pain being the leading symptom. The enlargement of the bone is readily recognised.

Treatment.—That for chronic periostitis. Linear osteotomy may give much relief, but is only suitable to cases in which the pain is comparatively localised.

RAREFACTIVE OSTEITIS—CARIES

Causes.—Rarefactive osteitis may be due to syphilis or injury, or may be secondary to disease of a joint, but in the great majority of cases it is of tubercular origin.

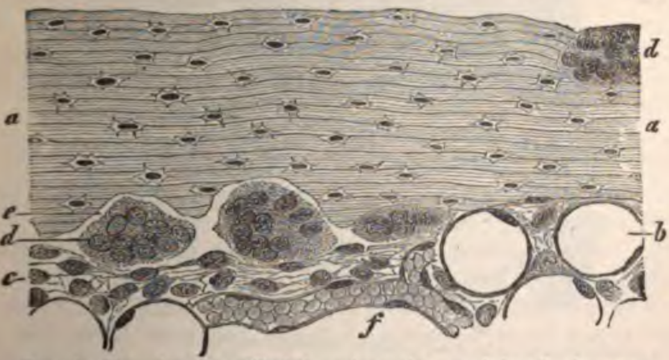

FIG. 36.—Absorption of bone (Ziegler). *a*, bone substance; *b*, fat cells of marrow; *c*, round cells; *d*, osteoclasts; *e*, Howship's lacunæ; *f*, blood-vessel.

Situation.—Caries usually begins in the cancellous tissue, and hence is most commonly seen in the ends of long bones, the bodies of the vertebræ, the bones of the tarsus, and in the phalanges.

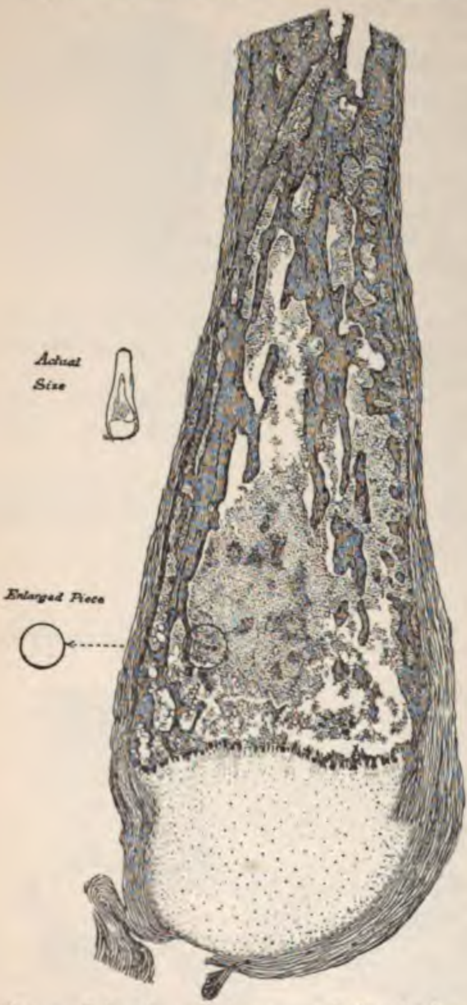

FIG. 37.—Tubercular caries from a case of tubercular dactylitis in a child fifteen months old who had numerous other tubercular lesions. The inflammatory tissue pervades the whole diaphysis. See also Fig. 38. (Drawn by C. H. Freeman.)

Morbid anatomy.—The disease is really an osteomyelitis, the destruction of the bony tissue being secondary to inflammatory changes occurring in the marrow of the cancellous spaces. The vessels in the Haversian canals are engorged with blood, and the inflammatory exudate fills the cancellous spaces. The bony walls become decalcified as the earthy salts are removed. The destruction of bony tissue is brought about by the agency of large multinucleated cells (*osteoclasts*), which eat out the bone and lie in small spaces known as Howship's lacunæ or lacunar corrosions (Fig. 36, p. 123). The area from which the bony tissue has been removed is filled with granulation tissue (Fig. 37). By a gradual extension of this process the bone assumes a characteristic worm-eaten appearance, and its density and strength are materially diminished.

In tubercular caries there are often many independent foci of tubercular deposit which, gradually increasing in size and coalescing, lead to extensive destruction.

In osteitis, as in inflammation of soft structures, suppuration may or may not occur. In the former case the abscess may be confined within the bone (*bone abscess*, p. 128, Fig. 41), but more often the pus gradually perforates the thickened periosteum and passes along the cellular planes until it reaches the surface. The sinuses leading to carious bone are often long and tortuous, their mouths by no means corresponding to the position of the carious area. The mouth of such a sinus is filled with exuberant, flabby granulations which project from it; on probing, considerable bleeding and pain are caused, especially when the probe comes down upon the friable and inflamed bone.

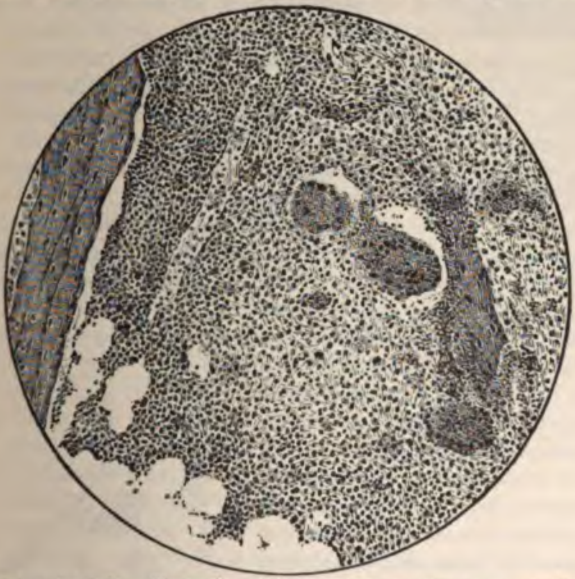

FIG. 38.—Tubercular caries. Giant cells and inflammatory exudation are seen with two pieces of bone which are being destroyed. From Fig. 37. (Drawn by C. H. Freeman.)

Whenever rarefactive osteitis is in progress, the chronic irritation excites osteoplastic periostitis and sclerosing osteitis, which may extend to the medulla and obliterate the canal.

Varieties of the process.—Sometimes rarefactive osteitis is unaccompanied by suppuration (*dry caries, caries sicca*), and the inflammatory products undergo partial absorption, caseation, and calcification, the process being analogous with that occurring in tubercular foci in soft structures. As the osteitis extends it may cut off small areas of bone from their blood supply, and these separate as sequestra (*caries necrotica*).

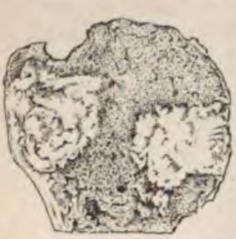

FIG. 39.—Two caseous patches of tubercle in the head of the humerus of a man æt. sixty-four. The articular surface is bare and the joint was diseased. Excision was performed with permanent success (Westminster Hospital Museum, No. 169A. Drawn by C. H. Freeman).

Caries may be *superficial*, *central*, or *articular*, according to its primary seat. Central caries or bone abscess is referred to at p. 127; articular or fungating caries gradually spreads towards and involves the joint cavity (see p. 155).

Signs.—In the majority of cases rarefactive osteitis is a very chronic disease. Its leading feature (apart from those which may be dependent upon its situation, *e.g.* the spine) is intense, deep-seated, aching pain, increasing at night and aggravated by change of temperature, by damp, or by even the gentlest percussion. Owing to associated periostitis the bone is enlarged. When suppuration occurs and the pus, perforating the periosteum, approaches the skin, the latter shares in the inflammation and becomes thinned, reddened, and finally perforated. The nature of the sinuses has been already referred to. If the caries affects the articular end, the signs of arthritis are predominant.

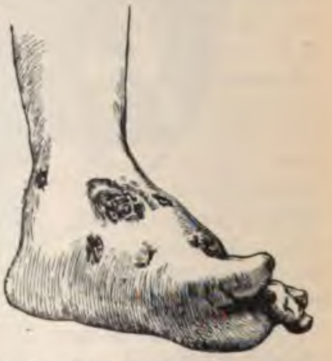

FIG. 40.—Tubercular disease of the tarsus of twenty years' duration. The other foot was in the same state; both were removed by Syme's amputation. The patient, a woman æt. thirty, was in good general health (Drawn by C. H. Freeman).

In very chronic cases with intractable suppuration (*e.g.* spinal caries) the general health suffers; the patient becomes anæmic and weak, and the organs may be the seat of fatty or albuminoid change, or should the discharges become septic, chronic septic intoxication may materially undermine the patient's health and strength and eventually prove fatal. In tubercular cases he may exhibit some other tubercular lesion.

Treatment.—Before suppuration has occurred treatment may arrest the process. The patient should be placed under the best possible conditions as regards food and fresh air. Cod-liver oil, the syrup of the hypophosphites, quinine, iron, and arsenic may be given as tonics.

Gradually increasing doses of iodide of potassium may materially lessen the pain and cut short the inflammation, or linear osteotomy may be resorted to. Complete rest of the part is essential.

When once suppuration has occurred nothing avails but complete removal of the area of disease, just as would be done in tubercular disease of soft structures. The part should be rendered bloodless and the carious area freely exposed by an incision, combined with the cutting away of sufficient bone to give access to the entire area of disease. The inflamed bone is then scraped away with a gouge, flushing gouge, and sharp-spoon; no part must be neglected, but the surgeon may know when he has done enough by the increased resistance and density of the tissue. All the débris having been washed away, the cavity should be swabbed out with zinc chloride solution (40 gr. ad ℥i.) or iodoform emulsion, and should then be dried and dressed antiseptically.

The dressing should not be touched for ten days or more, unless discharge soaks through or the general condition of the patient necessitates it. The second and subsequent dressings should similarly be left undisturbed for many days. Healing is always slow, since it is accomplished by granulation only, the dense bone being unable to contract. If the disease shows any tendency to recur, the operation must be repeated.

When caries attacks one of the small bones, *e.g.* of the tarsus, it may be completely removed. Amputation is usually necessary in cases of articular caries with involvement of the joint, and sometimes also when the disease is very chronic and the prolonged suppuration is threatening the patient's life.

BONE ABSCESS—CENTRAL CARIES

Localised central caries, accompanied by suppuration (*bone abscess*), is usually met with in young adults. It affects the ends of long bones, especially the head of the tibia, and is due to tubercular inflammation.

Morbid anatomy.—The abscess cavity is usually small and surrounded by dense bone, the result of chronic osteitis. In consequence of the deep-seated irritation, the chronically inflamed periosteum throws out new bone which causes considerable enlargement, such as might be produced by the growth of an endosteal tumour (Fig. 41). The abscess cavity is lined with a layer of granulation tissue, and may contain a small sequestrum. By the gradual destruction of the bone the pus may eventually perforate it, and the abscess discharge externally; or it may burst into the joint and set up acute arthritis.

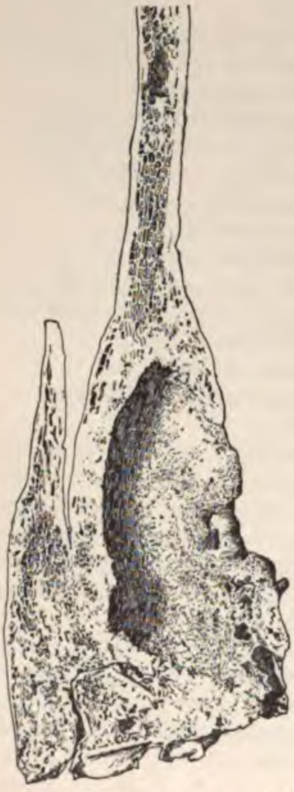

FIG. 41.—Abscess in the lower end of the tibia which has burst on the inner surface through the cloaca seen in section. The tibia, fibula, and astragalus are ankylosed (Westminster Hospital Museum, No. 182. Drawn by C. H. Freeman).

Signs. — The case is usually slowly progressive, although the symptoms may persist for months or years. The bone is enlarged and extremely tender on percussion, the pain being often very acute at one particular spot. The usual aching pain of caries is present, but the pain is subject to remissions, the patient sometimes being comparatively free from it for weeks together. The diagnosis has to be made from an endosteal growth, the main points of difference being the greater rapidity of growth and the comparative absence of pain in the latter condition, in which, moreover, the pain is more diffused. In bone abscess there is never egg-shell crackling as in some cases of tumour, but there may be some redness and œdema of the skin; moreover, complete rest may be followed by definite diminution in the size of the swelling and relief of the pain. In any case of doubt the diagnosis must be cleared up by trephining and exploration.

Treatment.—In the early stages it is impossible to determine the presence of pus, and the case should be treated on an expectant plan in the hope that the osteitis may subside. When the long continuance of the symptoms and the severity of the pain demand more active treatment, the bone should be trephined at the seat of greatest pain. Should pus be found, the opening must be enlarged and the carious area freely sharp-spooned. After trephining no pus may be met with, but in such cases the symptoms will subside from relief of tension, and if an abscess has been missed pus will escape externally in a few days (see Treatment of Caries, p. 127).

OSTEOMYELITIS

SIMPLE NON-INFECTIVE OSTEOMYELITIS

The simplest form of osteomyelitis is met with in cases of fracture or amputation and results in the formation of callus, which in the former serves to repair the damage, and in the latter blocks up the end of the medullary canal. It may also accompany osteitis or necrosis, the medullary canal thus becoming obliterated by new bone (Fig. 35, p. 122).

TUBERCULAR OSTEOMYELITIS

Bone abscess is essentially dependent upon tubercular inflammation originating in the medullary tissue of the heads of long bones, and has been already described (p. 127).

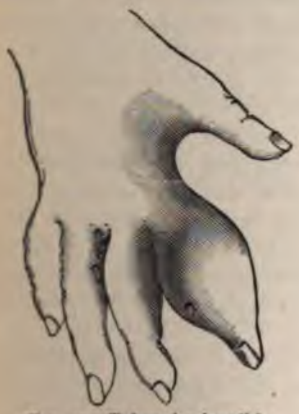

FIG. 42.—Tubercular dactylitis (Follin, after Parrot).

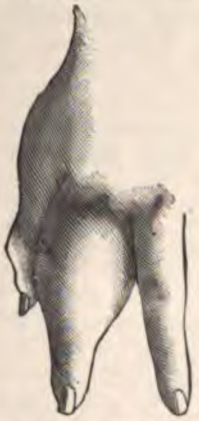

FIG. 43.—Tubercular dactylitis (Follin, after Parrot).

Very rarely, general acute tubercular inflammation originates in the medullary canal.

Tubercular osteomyelitis frequently attacks the phalanges, giving rise to the condition known as tubercular dactylitis (Figs. 42, 43, p. 129). The finger is much swollen, chiefly from enlargement of the bone; but later on, when suppuration has occurred, the soft structures are also inflamed and swollen and the pus is discharged externally. The affection is usually painless, and may affect many phalanges or the metacarpal bones, but the joints usually escape.

The **treatment** of tubercular osteomyelitis is practically that of caries; the area of disease must be thoroughly exposed and sharp-spooned, but if very extensive, amputation may be necessary. In the case of dactylitis, the greater portion of the shaft of the bone may be subperiostially resected with good results.

ACUTE DIFFUSE SEPTIC AND INFECTIVE OSTEOMYELITIS

This serious condition may occur after compound fracture or amputation, or, independently of these, may be the starting-point of acute necrosis (p. 119). If the wound becomes septic the products of putrefaction are absorbed by the medulla, and the inflammation thus excited favours the attack of pathogenic organisms. No one organism can be held responsible for the mischief, which may be lighted up by any of those capable of inducing septic or acute infective processes.

Morbid anatomy.—The congested vessels of the medulla pour out inflammatory exudation which infiltrates and gradually replaces the medulla. The inflammation rapidly passes to the stage of suppuration and extends to the spaces of the cancellous tissue, large portions of which may necrose.

The veins participate in the process and become blocked by infective clot which soon disintegrates, and the detritus, being carried to distant parts, causes general embolic pyæmia. The periosteum is inflamed, and suppuration may occur beneath it and strip it off the bone for some distance, but if the disease is not very acute and is cut short by treatment, the periostitis causes a deposit of new bone round the shaft; the necrosed part of the cancellous tissue separates in the course of time. If there be a wound of the soft structures this is always unhealthy, the discharges putrefy, and there may be some infective process (*e.g.* erysipelas), to extension of which the osteomyelitis is due.

Symptoms.—The onset is usually sudden; the patient is seized with a rigor or shivering fits, the temperature rises 4° or 5° F., and the severe constitutional symptoms commonly met with in acute infective inflammations set in.

On examination of the wound, *e.g.* after an amputation, it will found to be inflamed, swollen, and tender; the discharge is unhealthy and offensive; the soft parts are more or less retracted from the bone, which, blackened and discoloured, is laid bare. The exposed bone is denuded of periosteum for a variable distance, and projecting from the medullary canal is a mass of fungous granulation tissue of an ashy-grey colour. Probing the medulla does not cause pain or bleeding until the already dead area is passed, and the probe impinges on still living but inflamed tissue. The lymphatics are usually engorged and are visible as red, tender lines in the skin. The local pain is severe.

If general systemic infection occurs, there will be evidence of secondary inflammatory centres, and the general symptoms assume the typhoid type.

Treatment.—The chief indication is to rid the patient of the infective centre. The wound in the soft parts must be thoroughly cleansed, and the discharges rendered aseptic. In dealing with the bone several courses are open to the surgeon, the selection of any one being determined by the seat of the mischief and the general circumstances of the case.

Amputation is the surest method of ridding the patient of the infective centre; in cases where it would not be attended with too much shock it should be performed at the next joint, so as to remove the whole bone; but if the disease is apparently limited to the lower part of a bone, and amputation at the next joint would be hazardous, the operation may be performed in the continuity of the affected bone. Thus, supposing osteomyelitis should attack the lower end of the femur, it would be highly injudicious to amputate at the hip joint, and the operation must be performed lower down; or if the disease should occur in the stump after amputation in the middle of the thigh, it would be wiser either to disarticulate the bone through a prolongation upwards of the original wound or to rely on the sharp-spoon.

If the general condition of the patient negatives the performance of amputation, the bone must be thoroughly exposed and the medullary cavity freely sharp-spooned, so that all the infective material may be removed; it should then be mopped over with 1 : 500 mercury solution and lightly packed with double cyanide gauze. By the early adoption of one or other of these means, osteophlebitis and general blood-poisoning may be averted and the patient may eventually recover.

The general treatment is that given on p. 215, vol. i., as applicable to infective processes generally.

EPIPHYSITIS

SIMPLE EPIPHYSITIS

Simple epiphysitis occurs as the result of injury. The damage excites a mild and transient form of inflammation, the exudate organises, and growth may be more or less impaired in consequence of ossification at the epiphysary line.

TUBERCULAR AND SYPHILITIC EPIPHYSITIS

In both these conditions the inflammatory material infiltrates the growing epiphysary line, but by no means necessarily spreads right along it. In the course of time and under proper treatment the disease may subside, with practically no permanent injurious effects. This is especially likely to be the case in the syphilitic form, since the dyscrasia is very amenable to mercurial treatment and suppuration is unusual.

In tubercular cases suppuration frequently ensues, and the abscess gradually spreads along the line of the epiphysis to the surface, where it ultimately bursts. If the epiphysis lies within the capsule of the joint, as in the hip, the abscess bursts into its cavity and excites tubercular arthritis (see p. 155).

Symptoms.—The child keeps the limb quite still and cries if it be handled. There is considerable swelling and redness, but the movements of the joint are unaffected, although perhaps painful. When suppuration has occurred, the soft structures participate in the inflammation; softening at one spot becomes apparent, and the abscess, if left, opens on to the surface. The epiphysis may be completely separated—a fact indicated by dull crepitus on moving the diaphysis. Sometimes the epiphysary centre itself necroses.

Treatment.—Complete rest by means of a light splint is essential, and in syphilitic cases mercury should be administered. If the case progresses favourably, rest should be observed for some months after all traces of active disease have disappeared, otherwise the mischief may be reawakened. When it is evident that suppuration has occurred, the abscess should be opened and sharp-spooned, the case being practically treated like one of caries. Involvement of the joint demands the treatment for arthritis, and may necessitate amputation.

ACUTE INFECTIVE EPIPHYSITIS

Infective epiphysitis is due to the same conditions which lead to a similar affection of the periosteum or medulla.

The infective agent may gain access to the body through a small wound or, in quite young children, through the umbilical cord.

Suppuration rapidly ensues; the disease spreads along the growing line, separates the epiphysis, passes beneath the periosteum, and sometimes into the medullary cavity.

Acute necrosis results, and if the epiphysis is within the capsule of the joint, acute arthritis is set up and the separated epiphysis lies loose within the joint capsule. Death may occur from general embolic infection, or, should the child recover, the future growth of the limb is seriously impaired by premature ossification at the growing line.

Symptoms.—The onset is sudden, and the progress of the disease marked by considerable elevation of temperature and constitutional disturbance.

Locally the signs will be those of acute arthritis, if the joint is implicated either by the pus perforating the cartilage or in consequence of the epiphysary line being within the capsule. At the end of the bone there is swelling, redness, and great pain, especially on movement. When suppuration occurs the local and constitutional symptoms are aggravated, the swelling softens at one point, and the pus is evacuated. If the epiphysis be completely separated, there is movement between it and the diaphysis, accompanied by grating.

Treatment.—As soon as suppuration has occurred the abscess must be opened and the walls carefully sharp-spooned, great care being taken not to open the joint. The limb must be kept at rest, and the acute inflammation subdued by hot boracic fomentations. If the joint is involved it must be opened and cleansed, and the epiphysis, if found loose, should be removed. The general treatment is that applicable to all acute inflammations accompanied by high fever.

NECROSIS

Etiology.—Necrosis of bone is analogous to gangrene of soft parts and, like it, is due to any cause—traumatic or inflammatory—which cuts off the blood supply or diminishes it below a certain point. It has already been pointed out that the vascular supply of bone is derived from the periosteal and medullary vessels, and further, that although these anastomose, collateral circulation is imperfect, owing to the fact that the vessels run in dense channels, which materially interfere with their dilatation (p. 104).

The periosteal blood supply may be cut off by separation of the membrane in consequence of suppuration or injury, but such separation does not necessarily entail necrosis, especially if asepsis be secured. The bones of the cranial vault are more likely to die from such causes than are others, partly because the reparative power of their periosteum is poor and the vascular supply from the meningeal vessels slight, but chiefly, in accidental cases, because septic material is so commonly introduced. Phosphorus and mercury poisoning sometimes lead to necrosis of the jaws (see p. 315).

As regards the medullary circulation, necrosis may be induced by osteomyelitis or caries, which may be due to tubercular or syphilitic inflammation, or to acute infection.

Morbid anatomy.—The extent and position of the necrosis depend in the main upon its cause. Necrosis due to purely local causes is equally limited, but when caused by some infective process or constitutional condition, *e.g.* syphilis, a much larger area may suffer. If there is limited separation of the periosteum, the necrosed area is limited to the surface denuded (*exfoliation or peripheral necrosis*); but if the case is dependent on an acute infective inflammation, more or less of the whole shaft may perish (Fig. 33, p. 119).

When necrosis is due to inflammation of the medulla or cancellous tissue, the inner parts of the bone die (*included and central necrosis*, Fig. 44), while in cases where the periosteal and medullary vessels are both obliterated, the whole thickness of the bone perishes (*total necrosis*).

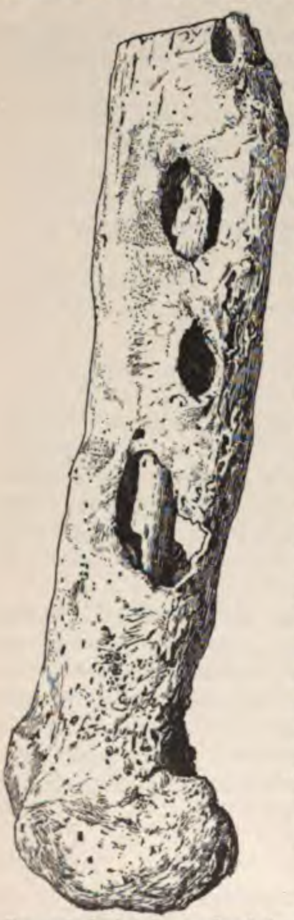

FIG. 44.—Included necrosis of the femur. The bone is enlarged by chronic inflammation, and is perforated by sinuses or cloacæ exposing the sequestrum (Westminster Hospital Museum, No. 201. Drawn by C. H. Freeman).

Necrosis is always accompanied by chronic osteitis and periostitis, and—when separation of the dead part is in progress—by suppurative caries, in the same way that gangrene of soft parts excites suppuration and ulceration of the adjacent living structures. The new bone enclosing an included sequestrum is known as the involucrum, and is perforated by more or less rounded apertures or cloacæ for the exit of discharge (Fig. 44); these correspond to sinuses in the soft parts.

Separation of the dead portion—Sequestration.—A portion of dead bone is practically a foreign body and excites inflammation and suppuration in the living bone, in consequence of which the dead piece becomes eventually separated. At the line of junction of the dead and living parts there is an irregular, worm-eaten, carious line filled by granulations; this gradually extends in depth and isolates the dead portion, which then lies quite loose in a granulating cavity. The sequestrum is bathed in pus, which finds exit through apertures (*cloacæ*) in the bony shell which locks in the sequestrum, and these communicate with sinuses in the soft parts (Fig. 45). In some cases the sequestrum—especially when of moderate size and superficial—may be gradually pushed out by the growing granulations, and the cavity may then heal; quite small sequestra may undergo complete absorption by the osteoclasts, but more commonly the shape and size of the sequestrum, or the fact of its imprisonment by new bone, necessitate its removal by the surgeon. When repair takes place the new bone is much denser than normal, and the shaft is thickened by chronic periostitis.

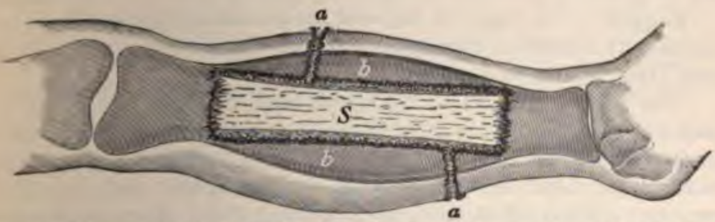

FIG. 45.—Diagram of total necrosis of the diaphysis of the tibia. *a*, *a*, cloacæ; *b*, *b*, involucrum of new bone; *S*, sequestrum (Tillmans).

Characters of sequestra.—The general appearance of a sequestrum depends partly upon its situation, but chiefly upon the cause of the necrosis. Sequestra due to separation of the periosteum by injury, or to actual detachment of a portion of bone, look like ordinary macerated bone, except on the side which has been separated by caries. All sequestra which have long been in a cavity containing putrid pus are of a dirty brown or black colour, from the formation of sulphide of iron during the process of decomposition.

When a sequestrum is due to inflammation, the evidence of that process is stamped upon it. It is more or less spiculated, and the surface worm-eaten through partial absorption by the osteoclasts concerned in the carious process to which loosening of the dead portion was due. A sequestrum from an amputation stump, being due to osteomyelitis extending upwards from the sawn end of the bone, is more or less conical in shape; the lower end includes the whole thickness of the bone, since the outer layer has died from the separation of the periosteum caused by sawing the bone; the upper end is spiculated, and the outer surface pitted and worm-eaten. The sequestrum from a case of phosphorus necrosis of the jaw is frequently covered with spongy, pumice-stone-like material (see p. 316).

Signs.—The signs of necrosis are practically those of the inflammatory condition causing it, coupled with the detection of the dead bone by the probe.

The sinuses leading to necrosed bone may be very long and tortuous, the pus having passed some distance beneath the deep fascia before reaching the surface. The pain and bleeding on probing are much less than in the case of caries, and the probe impinges against dense, hard, painless bone which gives a characteristic feeling and sound. If the dead bone is already sequestrated, it will be found to "rock" under the pressure of the probe. In some cases of included necrosis, such as may occur from syphilis, the symptoms are those of chronic osteitis, and there may be no suppuration externally, so that the diagnosis is inferential only, the true nature of the mischief being discovered when the bone has been cut into, in consequence of the severe pain thereby occasioned.

If the time occupied in sequestration be very long, and if during it the patient is suppurating freely, he may fall into a debilitated condition owing to the constant drain on the system and the continuous pain. Fatty and albuminoid degeneration or chronic septic intoxication may also result.

Treatment.—No attempt must be made to remove the dead bone until it is found to be quite loose. Pending this time, which may be delayed for many months, free openings must be maintained for the escape of pus and every effort made to prevent decomposition. If there be much pain, with perhaps slight fever, examination will generally reveal pent-up pus, and some operative measure to give free drainage will be needed. During the stage of separation every care must be taken to keep the patient's health as good as possible; good food, malt liquors, tonics, and residence in a bracing seaside place being very desirable.

As soon as the sequestrum is quite loose it must be removed. The area of disease should be freely exposed, and the involucrum of new bone cut away sufficiently to expose the whole sequestrum. This is then lifted out, being previously divided by bone forceps if necessary. The cavity must be carefully examined to ascertain that no portion of the sequestrum has been accidentally broken off and left behind; it should then be sharp-spooned and treated as a case of caries. Any old sinuses in the soft parts should be carefully scraped, or their walls excised, and the wounds treated aseptically. In very extensive cases, and especially if the patient's health is suffering severely, amputation is the wisest course, since separation will take so long and tax the patient's powers so much as to endanger his life.

NECROSIS WITHOUT SUPPURATION—DRY OR QUIET NECROSIS

In rare cases necrosis occurs without the formation of pus, although some suppurative inflammation of the periosteum may have preceded the mischief. Syphilis and tubercle may occasion sclerosis of bone with subsequent death; but if pyogenic cocci are excluded from the seat of mischief, suppuration does not occur; the sequestrum—separated by non-suppurative caries—lying in a cavity lined by granulations, and being locked in by condensation of the surrounding bone, thickened by chronic periostitis.

When suppurative periostitis has preceded the necrosis, the abscess may have been healed many weeks before the necrosis is detected. Watson Cheyne explains these cases by supposing that the periosteal inflammation has cut off the blood supply from the subjacent bone, but that the pyogenic cocci not having penetrated and the abscess having healed, the bone being deprived of its blood supply necroses and acts as a simple foreign body endowed with mechanically irritating properties only.

The signs of dry necrosis are by no means distinctive; in some cases the diagnosis of chronic osteitis, central caries, or endosteal new growth has been made, the real nature of the case being only discovered when an exploratory operation has been undertaken, and even then the condition has occasionally been overlooked.

The treatment consists in exposing and removing the sequestrum.

SYPHILITIC DISEASE OF BONE[1]

In the secondary stage of syphilis, bone pains are very common, especially with the onset of the cutaneous eruption.

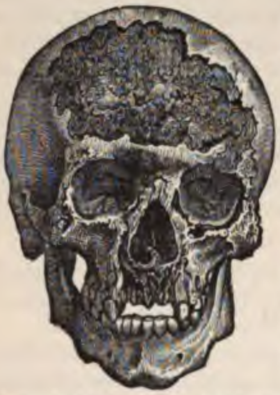

FIG. 46.—Syphilitic caries and necrosis of the bones of the skull (Musée Dupuytren. Follin).

Periostitis and osteitis are common tertiary manifestations. Periostitis leads to the formation of a gumma beneath the membrane, and the ossifying new tissue forms a localised, very painful swelling known as a node; or the inflammatory area may break down, burst externally, and lead to exfoliation of the bone beneath. Syphilitic periostitis is commonly seen on the tibiæ, the calvaria, and in connection with the bones of the nasal fossæ and palate. The situation of the mischief is important as regards the ultimate result; in the cranial and facial bones suppuration with subsequent necrosis is common, and may lead to perforation of the palate, destruction of the nasal septum, deformity of the nose, or to meningitis. Periostitis of the long bones usually ends in organisation and the production of a node, but when attacking the articular ends may lead to secondary disease of the joint (p. 173).

Osteitis is usually associated with periostitis, and the inflammation may spread throughout the bone, causing thickening and condensation, with obliteration of the medullary canal. In some cases this process obliterates the blood-vessels, and large portions of bone may necrose.

The treatment is that of syphilis, combined with such measures as are applicable to similar disease of bone occurring independently of the dyscrasia.

The bone changes in congenital syphilis have been described on p. 203, vol. i.

TUMOURS OF BONE

Various tumours are commonly met with growing primarily in the bones, and originating either from the deeper layers of the periosteum or within the bone itself, in the latter case almost always at one end where the cancellous tissue is most abundant. Periosteal tumours, being limited only by the soft tissues, grow more quickly, attain a larger size, and, if malignant, become disseminated more rapidly than do endosteal growths; they may leave the bone quite unaffected, or may cause erosion of its substance, which is replaced by the new growth.

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[1] See also vol. i. p. 188.

As an endosteal growth enlarges, the irritation produced excites osteoplastic periostitis, which enlarges the bone; as the growth of the tumour is more rapid than is the deposition of new bone, this gradually becomes absorbed, and subsequently the tumour may fungate through it, and grow into the surrounding tissues, where, being relieved of restraint, it increases in size more rapidly (Fig. 51, p. 143). A bone which is weakened by the presence of a tumour may undergo spontaneous fracture.

Tumours growing near joints rarely implicate them; but sometimes they spread beneath the cartilage, raise it up and enter the joint, and may, when malignant, invade the tissue of the other bone forming the joint. Flat bones may be perforated.

The symptoms produced by any tumour are dependent upon its actual nature and position and the pressure effects it may occasion, together with evidence of gradual enlargement of the bone accompanied by pain. The treatment varies in the different forms.

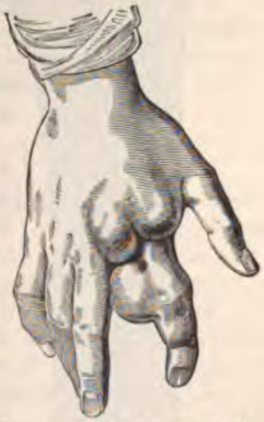

FIG. 47. — Chondromata of the second metacarpal bone and first phalanx of the index finger, which necessitated amputation (Fergusson).

CHONDROMATA[1]

Non-ossifying hyaline chondromata are often multiple, and grow in the interior of the phalanges of the fingers and toes, especially the former. Sometimes they spring from the perichondrium. When growing from the long bones, or from the scapula or pelvis, these tumours may be very large, are usually mixed with sarcomatous tissue, and are very prone to mucoid change; many of these are more correctly regarded as chondrifying sarcomata.

Signs.—These tumours usually appear in early life, and are often hereditary. Unless they are mixed with sarcoma tissue chondromata grow very slowly without invading the surrounding tissues; they are dense, hard, sometimes lobulated, and do not cause pain unless pressing on a nerve trunk.

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[1] For further information see vol. i. p. 241.

Treatment.—Enchondromata of the fingers may be readily enucleated after the investing shell of bone has been removed; if they are large, multiple, and causing much deformity, or if the bone is extensively destroyed, amputation must be performed. Pelvic chondromata are not usually amenable to surgical removal. Rapidly growing chondromata of the long bones demand amputation, since they are usually sarcomatous.

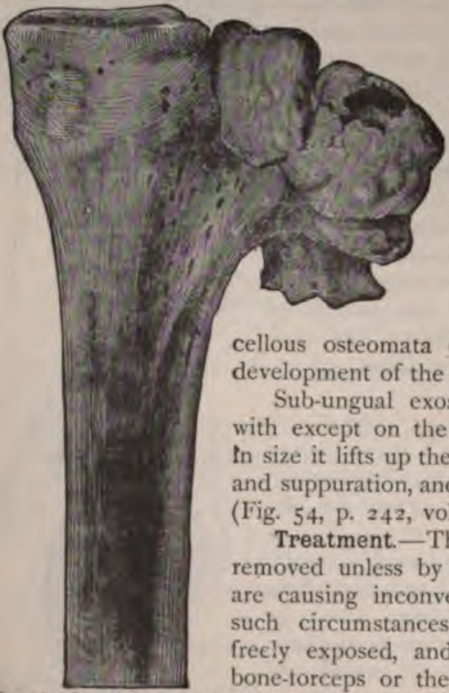

FIG. 48.—Cancellous osteoma of the upper end of the diaphysis of the tibia (Ziegler).

OSTEOMATA[1]

The cancellous osteoma very rarely appears after the twentieth year; it may be hereditary. These growths may be multiple, and are often symmetrical. They frequently occur on the inner side of the femur near the lower end. Cancellous osteomata cease to grow when the development of the skeleton is complete.

Sub-ungual exostosis is very rarely met with except on the great toe; as it increases in size it lifts up the nail, excites inflammation and suppuration, and causes considerable pain (Fig. 54, p. 242, vol. i.).

Treatment.—These tumours need not be removed unless by their size or position they are causing inconvenience or pain. Under such circumstances the tumour should be freely exposed, and the base divided with bone-forceps or the saw; the wound may be closed without drainage.

In cases of sub-ungual exostosis the nail should be removed, and the whole of the tumour gouged out; if any part be left, continuance of growth is almost certain to occur.

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[1] See vol. i. p. 242.

The compact or ivory osteoma is usually met with on the bones of the calvaria, and may occur at any period of life, and attain a large size. Growing from the inner table of the bone, in the frontal region, orbit or external meatus, the tumour may cause serious symptoms of pressure, demanding its removal; but when no inconvenience is occasioned, this should not be attempted, owing to the great density of the growth.

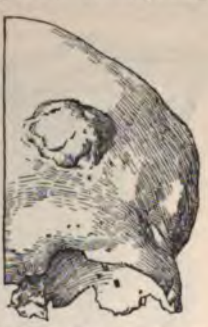

FIG. 49.—Ivory osteoma of the frontal bone (Westminster Hospital Museum, No. 244. Drawn by C. H. Freeman).

FIBROMATA[1]

Fibromata of bone spring from the periosteum, and may grow in any situation; these tumours are rare, excepting simple epulis of the jaw (p. 325) and naso-pharyngeal fibromata, which latter spring from the periosteum of the base of the skull (p. 269).

Fibromata clinically resemble the denser forms of sarcoma, with which they may be largely mixed; they grow less quickly, however, and do not tend to invade the bone or soft structures. They are usually quite painless.

Treatment.—Fibromata should be removed by such means as their situation allows. In the case of the long bones the tumour must, whenever possible, be removed without amputation, except in cases having sarcomatous properties.

SARCOMATA[2]

Morbid anatomy.—Primary sarcomata of bone may grow from the deeper layers of the periosteum, or in the cancellous tissue; these tumours are less common, but more malignant, in the former situation. Sarcomata are usually met with at the epiphysary ends of long bones, especially the opposed ends of the femur and tibia, and also in connection with the jaws, but no bone is exempt. They are frequently attributed by the patient to injury. The malignancy varies with the histological characters of the tumour, the spindle-celled variety being the worst, and the myeloid (fortunately the most common form) the most favourable in this respect. Sarcomata of bone are liable to all the degenerative changes met with in similar tumours elsewhere; they are sometimes very vascular, and pulsate freely (*osteo-aneurism*).

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[1] See also vol. i. p. 239.

[2] See also vol. i. p. 232.

As they invade the bone, this becomes much weakened, and spontaneous fracture may occur. The joint is rarely involved, but a tumour in the end of the bone may separate the cartilage, and, passing round its margin, may enter the articulation, and even spread to the other bone forming the joint.

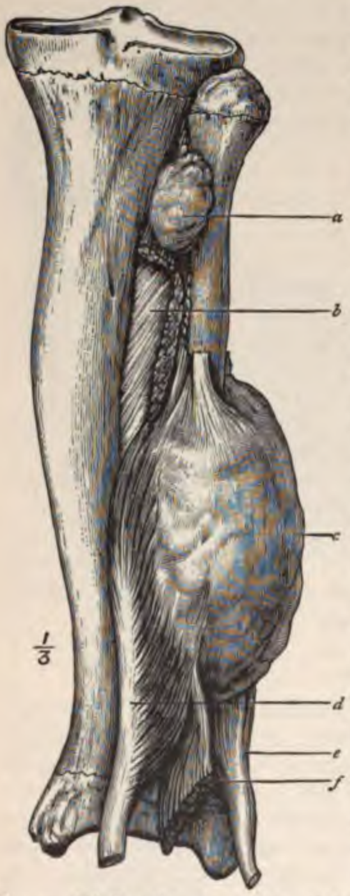

FIG 50—Spindle-celled sarcoma of the fibula (Bland-Sutton). *a*, accessory nodule of sarcoma; *b*, interosseous membrane; *c*, sarcoma; *d*, flexor longus hallucis; *e*, peroneus longus; *f*, detached portion of the flexor longus hallucis.

Periosteal or peripheral sarcomata are usually of the round or spindle-celled variety, and show a marked tendency to ossify (Fig. 47, p. 227, vol. i.). Ossification spreads from the bone, the bony spicules running into the tumour at right angles to the long axis of the shaft. Periosteal sarcomata grow rapidly and spread along the bone beneath the periosteum; they may erode the compact tissue and spread into the interior of the shaft. They remain encapsuled and stretch the soft structures over them. These tumours may attain an enormous size, and are frequently fusiform or conical in shape, the base being towards the joint. Their density varies with their histological characters and the presence or absence of degenerative softening.

Endosteal or central sarcomata are usually of the myeloid variety. They gradually replace the bony tissue and may spread along the medullary canal, infecting nearly the whole length of the bone.

The irritation causes osteoplastic periostitis. As the tumour increases in size the bony shell may be so thinned that it can be easily indented by pressure with the finger, and gives a peculiar sensation known as "egg-shell crackling." If the rate of growth of the tumour exceeds that of the deposition of new bone from the periosteum, the shell becomes perforated and the tumour, fungating into the surrounding tissues, grows more rapidly and may implicate and fungate through the skin (Fig. 51).

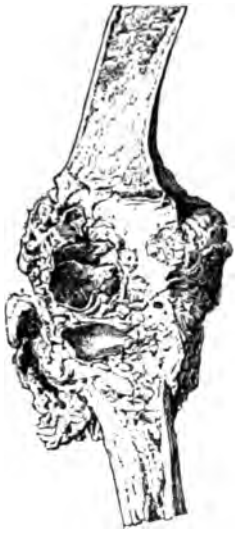

FIG. 51.—Cystic myeloid sarcoma of the head of the tibia. The tumour fungated through the skin and has invaded the lower end of the femur almost as far as the epiphysary line. This invasion followed partial ankylosis of the joint consequent on suppuration, which ensued on an attempt to eradicate the growth by sharp-spooning. From a girl at. seventeen (Westminster Hospital Museum, No. 249. Drawn by C. H. Freeman).

Varieties.—Myeloid, spindle-celled, round-celled, and melanotic may be met with, the last being usually a secondary deposit; their frequency is in the order given. The myeloid form is usually endosteal, the spindle- and round-celled forms periosteal. The myeloid sarcoma is the least malignant, and the prognosis as regards recurrence is favourable provided amputation has been early performed. The spindle-celled sarcoma is very malignant, especially when originating from the periosteum.

Diagnosis.—Sarcomata usually occur in early life, grow quickly, and are obviously connected with the bone. Small central tumours may cause some difficulty, since the enlargement of the bone and constant pain may be caused by osteitis, bone abscess, or non-suppurative necrosis. In doubtful cases the diagnosis must be cleared up by an exploratory operation.

Treatment.—Amputation is usually necessary, but in central myeloid sarcoma of the upper end of the humerus, of the radius, or fibula excision may be performed if the diagnosis be made early. In cases where the shock of amputation is not too great, this should be performed at the next joint, so that the whole of the affected bone is removed. In some cases, however, amputation in continuity is allowable; thus, in central sarcoma of the lower end of the femur (probably myeloid in nature), amputation may be performed in the middle of the thigh, the sawn end of the bone being carefully examined to ascertain that the point of section is well above the growth.

In the case of the scapula, clavicle, radius, ulna, and fibula, the affected bone may be completely or partially removed without sacrificing the whole limb.

CARCINOMATA

Cancer of bone, excluding certain tumours of the jaws (see p. 323), is a secondary manifestation only, and hence not subject to surgical treatment.

CYSTS OF BONE

Occasionally **hydatids** are met with in the long bones, pelvis, or spine; several bones may be affected, and hydatids may be present in the organs and soft tissues. The diagnosis is always obscure and usually not made until signs of enlargement, suppuration, necrosis, etc., demand operative interference, the nature of which must depend on circumstances. In some cases the bone gradually enlarges and the osseous tissue is absorbed, so that egg-shell crackling is present. This affection is usually painless.

The so-called dentigerous cyst is described at p. 326.

CHAPTER VI

DISEASES OF JOINTS

Anatomy.—The articular ends of bones are composed of cancellous tissue covered by a dense lamella of compact bone surmounted by a layer of hyaline cartilage, which is thickest at the points of greatest pressure. Articular cartilage has a tendency to split in a vertical direction, which tendency is more pronounced in pathological states. The ligaments uniting the bones are composed of dense white fibrous tissue; they are strong, flexible, but inextensible; the fibrous capsule is usually more or less loose, and is sometimes perforated by a small opening allowing communication between the synovial cavity and an extra-articular bursa, which may be the starting-point of joint disease. The synovial membrane advances a short distance on to the margin of the cartilage and there blends with it, but does not cover the surface; it lines the capsule and ligaments, and is reflected over ligamentous and tendinous structures which may, as in the shoulder and knee, traverse the joint. Where the membrane encroaches on the margin of the cartilage, it is thrown into folds—the Haversian fringes,—and on these again are smaller processes or secondary fringes (processes of Rainey), which are non-vascular. The synovial membrane is composed of delicate connective tissue, enclosing, where it forms the Haversian fringes, small collections of fat and sometimes cartilage cells. The vessels of the synovial membrane are numerous and run up into the Haversian fringes in the form of loops, the capillaries being here considerably dilated. The lymphatics of the synovial membrane do not appear to communicate with the joint cavity, nor do they approach so near to the inner surface of the synovial membrane as do the blood-vessels. Numerous nerves ramify in the membrane. It is worthy of note that the synovial membrane is physiologically the most important part of the joint, the bones, cartilages, and ligaments serving purely mechanical ends; it would, therefore, on *à priori* grounds be more probable that diseases of joints, when of primary origin, should begin in the synovial membrane; and such is the case.

General considerations.—Disease may originate in an articulation, or may spread to it from neighbouring structures. In the former case the synovial membrane is the point of attack; in the latter the mischief may be consecutive on caries or necrosis of the bones, on suppuration of a bursa, or on some other extra-articular disease. For clinical purposes, arthritis dependent on some general systemic infection may be considered as arising as a primary affection of the joint. Synovitis differs in its severity and course according to its cause, the resistant powers of the patient, and the method of treatment employed at the onset of the mischief. In the worst cases the mischief spreads to the ligaments, cartilages, and bones, and general arthritis ensues. The terms synovitis and arthritis refer merely to the extent of the morbid process and not to any special form of disease. In considering diseases of the joints we have to inquire how the various phases of inflammation with which we are already familiar will affect a part the integrity of which is of such mechanical importance. Synovitis may be caused by any of the agents already shown to be capable of exciting inflammation, and it must be noted that the synovial membrane is very prone to inflame under slight forms of irritation; moreover, the accumulation of synovium and inflammatory exudate in the cavity of the joint serves to perpetuate the inflammation which gave rise to it, by causing, *inter alia*, increased tension—a potent cause of irritation, and one by no means to be lost sight of in the treatment of synovitis.

ACUTE SIMPLE SEROUS SYNOVITIS

Etiology.—Simple acute synovitis is usually the result of traumatism. Sprains or twists of a joint, simple contusion, or the irritation of a foreign body, frequently excite more or less acute inflammation lasting a few days and terminating in resolution. Penetrating wounds, especially if contaminated by dirt, induce a more serious inflammation of a septic nature, which is often accompanied by suppuration. Simple synovitis may also occur as the result of exposure to cold, especially in rheumatic or gouty subjects.

Morbid anatomy.—The primary changes occur in the synovial fringes, which become hyperæmic and infiltrated with inflammatory exudate. The synovial membrane loses its polish and satin-like appearance, and rapid effusion of fluid into the joint follows, distending the capsule and causing considerable tension. The fluid is usually more watery than ordinary synovium, and if due to traumatism it may be bloody. Owing to admixture of escaped leucocytes and flocculi of lymph it is usually more or less turbid, even to a degree simulating sero-pus. Flakes of lymph—sometimes of considerable size—may be found floating in the effusion and coating the ligaments, capsule, and articular cartilages. Resolution is the rule; but in exceptional cases the inflammation spreads to the other structures of the joint and to the periarticular tissues, and ends in suppuration. Acute synovitis may become subacute or chronic.

Signs and symptoms.—The signs of acute synovitis are easily recognised in the more superficial joints, but may be more or less masked in those deeply seated, *e.g.* the hip. There are the usual signs of acute inflammation, viz. redness, swelling, heat, pain, and impairment of function.

Owing to the depth of the inflammation redness is but slightly marked even in quite superficial joints, and in the deeper ones is absent. The swelling, being dependent on effusion within the capsule, takes the outline of that structure, the prominences and depressions about the joint are obliterated, and the whole presents an unnatural, lifeless appearance. In the knee joint the swelling is chiefly noticed above the patella, the synovial pouches in this situation being distended with fluid, and the depressions normally seen on each side of the ligamentum patellæ are obliterated or replaced by prominences according to the amount of effusion, consequently the outlines of the patella and condyles of the femur are masked.

At the ankle the swelling is chiefly noticed in front, but it also extends round to the back of the joint. In the hip no swelling is noticeable unless the fluid accumulation is large in amount, when there will be fulness in the groin and behind the great trochanter. The shoulder, when affected, is broader and more rounded than normal; the depression below the acromion posteriorly, and that separating the shoulder from the chest are either obliterated or much less conspicuous than normal. At the elbow the swelling is indicated by a filling up of the depressions on each side of the triceps tendon, which, in consequence, is indicated by a groove. Synovial distension at the wrist joint is indicated by swelling on the dorsum, limited to the level of the joint and with its long axis transverse; the "snuff-box" is partially obliterated.

Swelling being dependent on fluid accumulation within the capsule, fluctuation may usually be detected. In the knee joint the patella floats—a fact which is readily demonstrated by pressing it backwards until it displaces the fluid behind it and strikes against the lower end of the femur. In order to allow of the greatest amount of fluid accumulation with the least tension, and consequently with the minimum of pain, the joint is kept in that position of natural rest which permits of relaxation of the ligaments and capsule; this position is, in most cases, that of semi-flexion.

In the more superficial joints the hand may detect some slight elevation of temperature, and the surface thermometer may indicate a rise of one or two degrees.

Pain is directly proportional to tension; it may be very severe, and is of a tensive, aching, sometimes throbbing character. It is much increased by movement and by any position that causes stretching of the ligamentous structures. The movements of an inflamed joint are impaired partly voluntarily and partly from reflex contraction of the muscles, especially those on the flexor aspect. The constitutional disturbance is very slight in simple cases; the temperature rarely exceeds 101° or 102° F., and even this subsides in a few days. When the acute stage subsides, in the course of three or four days, all the local and general signs gradually disappear; the fluid becomes absorbed, and the joint, perhaps at first a little stiff and conveying to the patient a feeling of insecurity, regains its normal state.

Treatment.—In acute synovitis, as in inflammation elsewhere, absolute rest is of the first importance. This may be effected by the application of a splint appropriate to the joint inflamed, or by support by means of pillows or sand-bags. In the case of the hip, weight extension is an excellent means of ensuring complete rest, the weight being regulated according to the age of the patient and the ease with which it can be borne. Rest should be maintained until all acute symptoms have subsided; but when resolution is occurring, and the effusion is undergoing absorption, gentle passive motion and massage will be found very useful.

If there is much tension, as evidenced by considerable swelling and severe pain, the fluid should be drawn off by aspiration. Not only does this give immediate relief, but it tends to lessen the inflammatory process, tension itself being a powerful cause of irritation. Moreover, the presence of a large quantity of fluid within the capsule acts injuriously by stretching the ligaments, and thereby encourages future weakness and laxity of the supporting structures. Aspiration must be conducted with strict asepsis, and the needle should be inserted into that part of the joint cavity which is most superficial.

The continuous application of cold by means of the ice-bag cuts short the inflammatory process, and limits the amount of effusion. While cold will usually be found the most serviceable local application, heat is sometimes preferable. Thus, in cases accompanied by considerable rise of temperature and marked local symptoms, indicating a very acute form of inflammation which threatens to run on to suppuration, the application of leeches, followed by hot fomentations, should be prescribed; this is, however, rarely necessary in simple acute synovitis.

On the subsidence of the acute stage, absorption of the fluid effusion may be hastened by passive motion, massage, friction, and the application of counter-irritants, such as repeated blisters. Strapping the joint not only aids absorption but gives support. If there is much laxity of the ligaments, and consequent feeling of insecurity, a support of elastic webbing or some firmer material to suit the requirements of the case, should be worn for some months.

During the acute stage the bowels must be kept acting by salines, and the diet must be light.

SUBACUTE AND CHRONIC SEROUS SYNOVITIS—HYDRARTHROSIS

Etiology.—Simple serous synovitis may become subacute or chronic, especially if treatment has been neglected or the joint used too early; in other cases the disease is chronic from the first. The continued irritation of a loose body producing repeated attacks of synovitis is a common cause of hydrops articuli. Chronic rheumatism, Charcot's disease, and tubercle may also cause hydrarthrosis.

Morbid anatomy.—The capsule is distended with clear serous fluid like diluted synovium, which, being inflammatory in origin, is rich in albumen. The chronic distension causes relaxation of the ligaments and capsule, with proportional weakness and instability of the joint. Any bursæ communicating with the joint cavity may be similarly distended with fluid, and, at certain weak spots in the capsule, cyst-like protrusions may occur, which project into the periarticular structures (*Morrant Baker's cysts*). Lymph is sometimes deposited on the ligaments and cartilages in considerable quantity. The synovial fringes, especially in rheumatic cases, undergo hypertrophy, forming grape-like pedunculated processes floating in the fluid. These processes may be the seat of cartilaginous or calcareous nodules (Fig. 65, p. 176), which, being nipped off during the movements of the joint, become loose bodies. Suppuration does not occur.

Signs.—The signs of hydrarthrosis are practically those of fluid in the joint, accompanied by weakness and a feeling of insecurity, but without the usual evidences of inflammation or much pain.

Fluctuation is present, and the outline of the capsule is more or less clearly defined. The fluid effusion, by distending the joint, tends to obliterate the normal elevations and depressions peculiar to the part, and in some cases converts a depression into a prominence, thereby making the normal prominences appear as depressions. Bursal accumulations and Morrant Baker's cysts may render the outline of the swelling irregular.

Prognosis.—In simple cases the disease usually clears up under appropriate treatment, and the joint, though weak at first, ultimately regains its normal state.

Should a loose body be present, no cure can be expected until this has been removed.

Treatment.—Any condition, *e.g.* a foreign body, tending to keep up irritation in the joint must be removed. In many cases rest on a splint aided by compression will effect a cure. Counter-irritation in the form of flying-blisters or the actual cautery, may be of great service if rest and compression do not benefit the case. Friction, massage, and douching tend to hasten the absorption of fluid when this has once commenced. In many cases of acute synovitis the fluid, on the subsidence of the acute symptoms, becomes partly absorbed, and then the process is arrested. Under such circumstances friction and gentle passive motion are very beneficial.

Aspiration of the joint is in most cases soon followed by reaccumulation of the fluid, but if other means fail it should be given a trial, the joint being firmly strapped or compressed by an elastic bandage after the fluid has been withdrawn.

In intractable cases the fluid may be withdrawn by a fine needle, and some mildly irritating fluid injected into the joint, with a view to exciting enough inflammation to restore the lost balance between secretion and absorption. The choice of fluid lies between carbolic acid, 1-40, and tincture of iodine, ʒi. ad ℥i., or a little stronger. The fluid being drawn off, the joint should be injected with one of the solutions mentioned, the amount used being equal to the quantity of fluid withdrawn; the joint should then be kneaded with the hand, in order to ensure the fluid passing into all parts of it; the latter should then be withdrawn, and the limb placed on a splint. A certain degree of acute synovitis will follow, which must be treated in the ordinary way. This proceeding is not entirely free from danger, for too much inflammation may ensue, leading to permanent impairment of the joint.

In the most resistant cases, when all other means have failed, antiseptic incision of the joint must be practised. The incision should be free, and the joint cavity should be examined with the finger in order that any loose body may be detected if present. The cavity should be thoroughly washed out with 1:20 carbolic acid solution, and any pendulous fringes and thickened synovial membrane should be removed. Drainage must be provided as long as there is much fluid escaping.

After injection or antiseptic drainage, a good and useful joint should be obtained.

When cure has been effected by one or other of the means indicated, the joint should be supported for a time by a cap of elastic webbing or other suitable material, and the movements should be improved by passive motion, cold douching, massage, and friction.

ACUTE SUPPURATIVE SYNOVITIS AND ARTHRITIS

Etiology.—Simple serous synovitis, as above described, very rarely terminates in suppuration.

Suppurative synovitis may follow penetrating wounds which have become the seat of septic poisoning, or may result in the course of some general infective process, the severity depending on the nature of the primary cause. Disease beginning in the articular end of a bone, or in the epiphysary line, when that lies within the capsule, may secondarily involve the articulation, and thus excite general suppurative arthritis. Suppuration in a bursa communicating with or close to the synovial cavity occasionally occurs, and leads to destructive changes in the joint. From the above it will be seen that suppurative arthritis may be dependent upon causes of purely local origin, or upon conditions, such as the infective processes and acute fevers, which profoundly affect the whole system; the latter class of cases are naturally the more serious in view of the general condition, and because they are usually, if not always, dependent upon some definite poison carried to the joint by means of the blood stream. This being the case, it is not surprising that frequently many joints are simultaneously or consecutively affected, and that the inflammation excited is of such severity as to induce suppuration. At the same time, all grades of intensity are met with, from acute transitory serous inflammation to rapid suppuration and destruction of the entire joint, with involvement of the surrounding parts. This proneness to destruction is further enhanced by the fact that the effusion into the joint finds no means of escape, and being endowed with septic properties, keeps up and aggravates the inflammation which gave it birth.

Morbid anatomy.—The early stages of the process are precisely similar to those detailed under acute serous synovitis (p. 146). When suppuration occurs the inflammation is no longer limited to the synovial membrane but spreads to all the structures entering into the formation of the joint. The ligaments are injected, infiltrated, swollen, and softened; the cartilage cells, in response to irritation, proliferate and undergo fatty degeneration; their capsules burst and the cell-detritus mixes with the effusion filling the joint. Small pits are thus formed, and these gradually deepen by progressive destruction of the deeper-lying cartilage cells; the matrix disintegrates more slowly, but eventually the whole cartilage is removed and the bone exposed (Fig. 52). In cases due to infective poisons the irritating toxines exert a powerful corrosive influence on the tissues. The erosion of the cartilage advances most rapidly at those parts which are in most intimate contact; sometimes inflammatory products pass between the cartilage and bone and separate the former in large flakes, which are cast into the joint. The exposed bone participates in the inflammation, the articular compact lamella is removed, and the cancellous tissue is exposed, the bone ends then becoming carious. The periarticular structures participate in the inflammation and become infiltrated with inflammatory exudate. The periosteum throws out new bone owing to the neighbouring irritation. Sooner or later the capsule of the joint bursts, and the pus, escaping into the soft structures, may burrow a considerable distance before it finally finds an exit externally. The joint being thus totally disorganised dislocation may

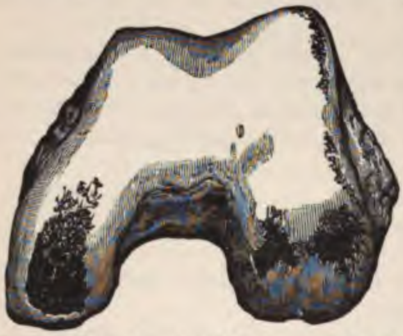
FIG. 52.—Ulceration of cartilage exposing the subjacent bone in acute suppurative arthritis (Howard Marsh, *Diseases of the Joints and Spine*, St. Bartholomew's Museum, No. 584).

ensue, partly because the joint surfaces are no longer adapted to each other, but chiefly on account of the muscular contraction excited by the irritation. Even at this stage recovery may occur, but permanent ankylosis results. In other cases the destruction will continue unless checked by radical treatment of an operative nature.

Symptoms.—The signs of suppurative synovitis are similar in nature, though more marked in severity, to those of the simple serous form (p. 147). With the advent of suppuration the constitutional symptoms are of a more pronounced type; the temperature rises to 103° F., or higher, and is accompanied by chills or rigors. If the joint affection is consequent on some general disease or infective process, the symptoms of the primary condition will be present; indeed, in some cases of pyæmia the constitutional state is so severe, and prostration with typhoid symptoms so conspicuous, that the joint affection may be overlooked. When arthritis is due to infection from within, many joints often suffer, though not in equal degree; some may suppurate, others do not and may completely recover.

Pain is usually a marked symptom; it is of a throbbing character, and is often specially referred to one part of the articulation. It increases when the cartilages become eroded and the bones are exposed and inflamed. At this time the patient experiences starting pains when he goes to sleep; these are due to sudden reflex contractions of the muscles excited by slight movement of the limb, and causing grating of the inflamed bone ends on each other. The joint is swollen and the capsule distended by fluid, though the outline of the latter is not accurately marked out, since there is some periarticular œdema masking it and making the swelling more uniform. The joint is semi-flexed, and in the position affording greatest relaxation of the ligaments. In most cases the redness over the joint is more or less patchy, and the cutaneous veins are engorged. When the capsule softens and the pus escapes there is increase of the cutaneous redness, with considerable œdema extending for some distance beyond the joint. Sinuses subsequently form, and dislocation may, but does not necessarily, ensue.

The muscles waste rapidly, and in some cases there may be reflex paralysis.

Terminations and prognosis.—Under favourable circumstances and prompt treatment, recovery may follow without any great impairment of motion. In the majority of cases, however, fibrous or osseous ankylosis will ensue. In the worst cases excision or amputation are required to save the patient from death from hectic, exhaustion, or some intercurrent infective process.

The prognosis of joint affections consequent on general infective processes is necessarily more serious than in cases of local origin. Other things being equal, the larger the joint the more serious the prognosis to life and limb. In children it should be remembered that growth at the epiphysary line may be seriously interfered with, or arrested, by suppuration of the adjacent joint.

Treatment.—In the case of wound of a joint great care must be taken that perfect asepsis is assured so that septic arthritis is prevented, any inflammation which may follow being then of the simple serous form (see Wounds of Joints, vol. ii. p. 118). In the early stages of acute synovitis, which from its cause is likely to run on to suppuration and involve the joint as a whole, the limb should be kept at perfect rest on a suitable splint; slight extension gives much relief by steadying the bones and counteracting muscular contraction. The starting pains may by this means be completely prevented. Opiates may be required, but are not usually necessary if rest and extension are properly effected. With regard to local applications hot fomentations are more grateful and effective than is the ice-bag; glycerine and belladonna may be painted over the joint, or if the pain is great and the cutaneous veins turgid, leeches should be applied. If there is much fluid effusion this should be removed by aspiration.

When the occurrence of rigors, high temperature, and increasing constitutional disturbance, coupled with starting pains, grating, and œdema of the soft parts, indicate the formation of pus, this should be evacuated by free incisions, one on either side of the joint at the most dependent point. If any doubt exists as to the presence of pus, a little of the fluid should be drawn off by an exploring syringe. The joint having been opened, its cavity must be freely flushed with 1 : 40 carbolic acid solution and efficient drainage secured. If drainage is difficult or cannot be efficiently maintained, the cavity should be continuously irrigated with warm boracic solution. The limb must be put up in that position which will prove most useful to the patient should recovery with ankylosis ensue.

In applying retentive apparatus care must be taken that dislocation is prevented, extension being used to counteract the tonic contraction of the muscles.

Under favourable conditions the suppurative process may cease, and repair set in after the evacuation and free drainage of the joint. Complete rest must be maintained for some time, but when all danger of relapse has passed passive motion and massage combined with elastic support may do much to secure a movable joint. Such a happy termination is, however, rare; more frequently fibrous or bony ankylosis results. In the worst cases the suppuration continues, and chronic mischief is established; the bone ends become destroyed by caries, and abscesses form in the soft parts; in such cases the only hope of saving the patient's life lies in excision or amputation. Amputation is much more commonly required than excision, partly on account of the extent of the disease rendering the latter operation impossible, and partly because in the depressed state of the patient's health the recuperative powers are not sufficient to repair an excision. Whichever operation is performed it should not, as a rule, be undertaken until all acute symptoms and constitutional disturbance have subsided.

TUBERCULAR ARTHRITIS—WHITE SWELLING

Etiology.—Tubercular arthritis is essentially a disease of early life, occurring chiefly in weakly, so-called strumous children, especially among those of the poorer classes who, as too frequently happens, are insufficiently and improperly fed and live amidst unhygienic surroundings. The onset of the disease is often attributed to some slight injury, perhaps so trivial as to have been hardly noticed; in other cases no such history is obtainable. Simple synovitis may be the starting-point of tubercular mischief. Injury and simple inflammation lay the tissues open to the attacks of the tubercle bacillus by lessening their vitality and resisting power.

Morbid anatomy.—While no joint is exempt, the hip, knee, and elbow are the more usual seats of tubercular mischief. The synovial membrane, the articular ends of the bones, or the epiphysary line may be the primary seat of the morbid process, the relative frequency of the point of attack varying in different joints.

Wherever it begins, the actual course of the process is practically the same, but the extent to which the individual bones suffer differs; thus, if the disease originates in the synovial membrane, all the bony surfaces will show about an equal degree of morbid action, whereas if it begins in one bone, the mischief will have advanced more in it than in the others forming the joint.

For purposes of description we will assume the synovial membrane to be the seat of primary attack. The process being essentially chronic, there is chronic congestion and hyperæmia of the membrane first noticeable in the Haversian fringes. As a rule there is little or no fluid exudate, but considerable cellular infiltration, which causes thickening of the fringes and, later, of the entire membrane. This so-called granulation tissue contains typical tubercular nodules (Fig. 53), and as it gradually increases in quantity, forms a compact mass completely filling the joint cavity and invading the ligamentous and other structures of the articulation. The new tissue is gelatinous and pulpy, and of a pinkish colour. The cartilages undergo erosion, carious pits are formed, and eventually the whole cartilage is removed and the exposed bone is next invaded. The cancellous tissue is infiltrated by granulation tissue, and the bony walls are absorbed; articular caries results, and portions of bone may separate as sequestra (caries necrotica, Fig. 56, p. 164). The ligaments and capsule are similarly invaded and destroyed, and the periarticular structures become implicated. Osteoplastic periostitis occurs at the articular margins in consequence of the chronic irritation (Fig. 55, p. 159).

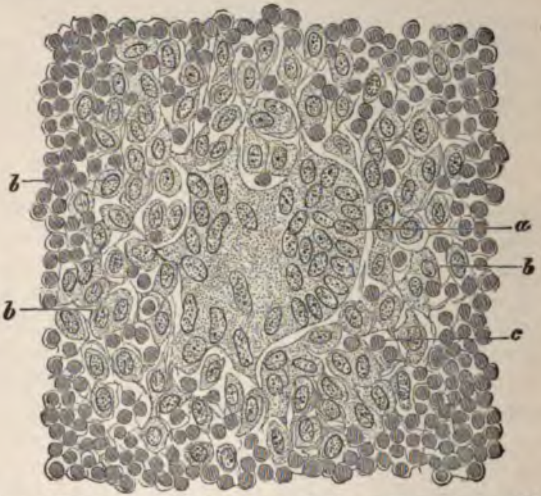

FIG. 53.—Tubercular nodule from a case of white swelling of the knee joint. *a*, giant cell; *b*, epithelioid cells; *c*, lymphoid cells (Ziegler).

Under favourable circumstances repair may set in before the disease has advanced to destruction of the bones and ligaments, the granulation tissue being partly absorbed and partly converted into fibrous tissue which entails some thickening with stiffness and limitation of movement of the joint.

Even at a late period, after softening and caseation have occurred, repair may ensue; the result being fibrous or osseous ankylosis according to the extent to which the cartilages and bones have been destroyed.

In the majority of cases, however, the nutrition of the new tissue is insufficient to maintain its vitality. Fatty degeneration and softening with the formation of chronic abscesses containing curdy pus result, or there may be simple caseation. These abscesses may remain more or less localised, and may even dry up and repair take place as above stated; more usually the suppurative process extends throughout the joint, and to the bones; the softened ligaments yield, the capsule gives way, and the abscesses, extending to the soft structures, eventually burst externally. With the total disorganisation of the joint, complete or partial dislocation may result from tonic muscular contraction.

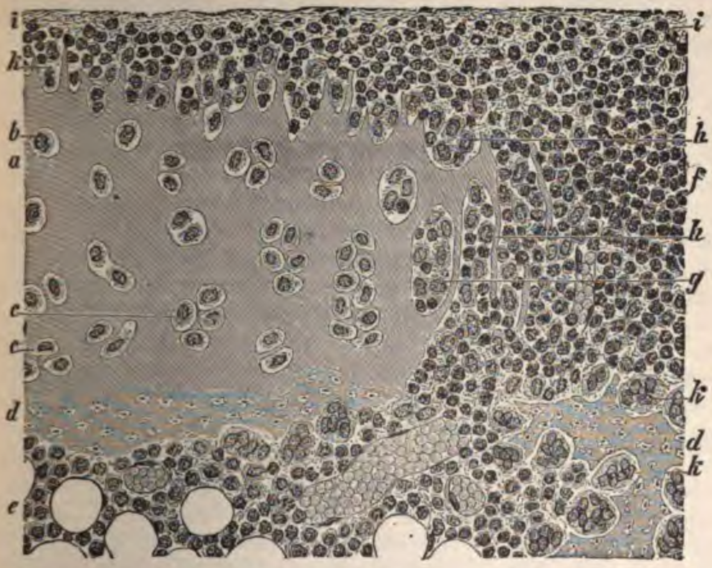

FIG. 54.—Tuberculous arthritis. × 100 (Ziegler). *a*, hyaline cartilage; *b* isolated, and *c* grouped, proliferous cartilage cells; *d*, osseous trabeculæ; *e*, bone-marrow; *f*, granulomatous tissue; *g*, proliferous cartilage cells mingled with round cells; *h*, dehiscent cell capsules; *i*, granulations covered over with fibrin; *k*, osteoclasts.

If the disease begins in the articular end of a bone the same processes occur as above detailed, but in the reverse order.

Symptoms.—In the early stages of tubercular disease, when the affection is limited to the synovial membrane, the symptoms are very slight. The onset is chronic, and is not usually marked by redness, pain, or increased heat, nor are there any constitutional symptoms. If a joint of the lower extremity be the seat of disease, slight lameness, with a feeling of insecurity, may be the first sign to attract attention. The joint will be found swollen, but on examination the swelling will prove to be elastic and doughy and not due to fluid. There is slight flexion and some limitation of movement, pain being elicited by forced movement beyond such limits. Resolution may occur even after many months, or an imperfect cure may be followed by further destruction. If the case progresses, as it usually does, the swelling increases and becomes more uniform; the skin over the joint is white and not markedly hot; the pain becomes more pronounced.

In the second stage, when the cartilages, bones, and ligaments are involved, the symptoms are more marked. Starting pains when the patient goes to sleep, grating on movement, a greater degree of flexion and tonic contraction of the muscles, especially the flexors, are all present. As already stated when discussing the morbid anatomy, recovery may take place, the swelling and other signs gradually subsiding, and the joint being restored to its former condition, with the exception of slight thickening and limitation of motion.

The third stage is that of softening and suppuration, the tubercular foci increasing in size and being cut off from all vascular supply. Pain is more severe and constant. Patches of softening can be made out, and the swelling extends to the periarticular structures; the softened patches may burst into what remains of the joint cavity, or may discharge externally, the periarticular structures —themselves tubercular—sharing in the process. In the latter case the process usually, but not necessarily, extends to the joint surfaces. Dislocation may follow.

With regard to the constitutional symptoms, there are none peculiar to the condition until the disease has advanced. In the later stages pain and continued suppuration occasion general loss of health with slight fever, and unless proper care be taken to prevent decomposition hectic may result.

Prognosis.—Tubercular disease of a joint is always a serious matter. It may extend over a long period of time, often many months, without advancing to any perceptible extent; in other cases the downward progress is more rapid, and complete destruction soon occurs. The prognosis depends in the main upon the general health of the patient and the care taken in the treatment of the early stages. More or less complete recovery may occur under proper treatment, provided the general health is good and the strumous dyscrasia not pronounced. In other cases temporary improvement may occur, only to be followed by fresh lighting up of the mischief and eventual destruction.

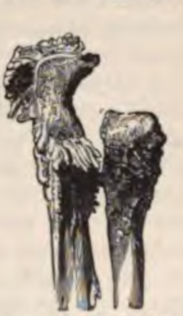

FIG. 55.—The bones of the left elbow joint from a case of tubercular disease. The cartilages have been destroyed by erosion; the articular surfaces are carious, and osteophytes are present round the ends of the bones (Fergusson).

In the later stages the main dangers to be apprehended and guarded against are exhaustion and hectic from prolonged suppuration and decomposition of the discharges, and some intercurrent tubercular mischief in the lungs, brain, etc.

Tubercle of the joints occurring in adults or in the aged shows a remarkable tendency towards destruction, the prognosis to the joint being at all times grave.

Treatment. — In the early stages of tubercular mischief of a joint our endeavours must be directed towards the encouragement of absorption of the inflammatory products and complete restoration of the joint. Absolute and prolonged rest is most essential. It lessens acute congestion and favours the development of cells into connective tissue; these isolate and then destroy the tubercular material. This condition of rest must be secured by the application of some form of splint suited to the joint, which should be placed in that position in which the limb will be most serviceable should adhesions form. When the joints of the lower limb are involved the patient should not be confined to bed unless the disease has reached an advanced stage rendering this necessary. By the use of Thomas's hip or knee splint for these joints, or of a back splint with a foot-piece in the case of the ankle, the patient may, with a patten or thick sole on the opposite side, be allowed about on crutches. Confinement to bed tends to weaken the health and muscular power. Rest should be maintained for some weeks or months after all pain and swelling have subsided, for if movement be allowed too early the disease will reappear. In addition to rest the inflamed joint may, if its position allows, be evenly compressed and supported by means of strapping. Some surgeons apply Ung. hydrarg. co. (Scott's dressing), or oleate of mercury and morphia spread on strips of lint and retained in place by carefully applied strapping; but the utility of these applications is more than doubtful; at the same time they can do no harm. Much more good may be done, especially when pain is marked, by the application of the actual cautery, followed, when the wounds have healed, by elastic pressure and continued rest. Repeated blistering may also be beneficial.

Considerable success sometimes attends the treatment by injection. One drachm of iodoform emulsion may be injected into the joint every week for a period of two to four months, but if improvement is not apparent in three weeks, it is probable that none will occur.

A 10 per cent solution of chloride of zinc is also recommended with a view to obliterating the vessels and thus diminishing the vascularity; two minims are injected into the synovial membrane at, say, half a dozen points, and the operation may be repeated in about a fortnight. A 20 per cent solution of carbolic acid used in the same way has also given good results. These methods are inappropriate in all but early stages of the disease, as they are liable to excite considerable inflammatory reaction which may give an impetus to the disease and lead to breaking down of caseous areas.

Bier of Kiel has adopted a method by which he induces venous hyperæmia. The limb is bandaged from below up, the bandage being fastened off below the joint, above which moderate compression is applied. This treatment is kept up constantly for some weeks. It is supposed that this artificial hyperæmia promotes the development of fibroid tissue, and hence the localisation and destruction of the tuberculous tissue. The utility of this treatment is open to grave doubt.

In the later stages of the disease, when the cartilages and ligaments are involved, when the pain is more constant, and the patient complains of startings on going to sleep, the same line of treatment must be adopted, coupled with slight extension. Even moderate extension suffices to prevent these painful starting pains, thereby allowing the patient many hours of sleep which would otherwise be impossible. Extension is especially useful if there is much tonic muscular contraction, for this is readily overcome by prolonged resistance. The relief afforded by weight extension is often immediate and marked, and as soon as the desired result has been obtained the weight must be diminished, or in a few days there may be some return of pain, due, in the absence of the previous muscular contraction, to tension and stretching of the inflamed ligaments.

If recovery ensues, cold douching, friction, and massage should be employed to overcome the stiffness left in the joint and to encourage the nutrition of the muscles, which will have suffered from long confinement and inactivity; and it is advisable, when movement is again allowed, that the joint should be supported by an elastic cap. No forced movement is ever permissible, as the damage inflicted may re-awaken the mischief.

The question of operation.—As soon as it is evident that no hope is to be expected from the curative powers of nature, aided by rest and expectant treatment, some operative procedure aiming at the complete removal of all the tubercular disease is necessary. Early operation allows of the removal of all diseased structures without the sacrifice of so much bone as was formerly the case, and hence the operative measures are less severe, and attended by less mutilation. While a great advance has been made in the treatment of tubercular joints by the early adoption of operative measures, these should not be undertaken until a fair trial has been given to expectant treatment; but, on the other hand, operation should not be delayed until suppuration has occurred, with perhaps the formation of septic sinuses. When the disease originates in the bone, operation is required at an earlier date than when its primary seat is the synovial membrane, and the same is true if the joint disease be complicated by other tubercular manifestations.

The choice of operations lies between arthrotomy and drainage, arthrectomy, complete excision, or amputation. When the destructive process is but slightly advanced, arthrectomy gives excellent results, if carefully conducted with strict antiseptic precautions. In the more advanced cases, where the bones are extensively involved, the ligaments softened and destroyed, and where sinuses extend among the periarticular structures, excision or amputation will be required. Excision should be performed in preference to amputation if the circumstances of the case permit of it; but if the general health has been deteriorated by prolonged pain and suppuration, and perhaps hectic, or if the patient is suffering from some other tuberculous manifestation, *e.g.* in the lungs, amputation is the wiser course.

TUBERCULAR HYDRARTHROSIS

In some cases, especially in young adults, a condition of diffuse tubercle of the synovial membrane is accompanied by copious fluid effusion. The disease is very chronic, and contrasts markedly with the changes met with in ordinary white swelling, which may, however, occur as a sequel. The synovial fringes are hypertrophied and pendulous, and may, during the movements of the joint, become separated, forming melon-seed bodies. Typical tubercular nodules are present in the fringes and synovial membrane.

The signs of the affection are those met with in simple hydrarthrosis; but it is extremely chronic, resists treatment, and is apt to develop into white swelling.

Treatment.—Complete rest, with strapping and treatment directed to the improvement of the general health, may effect a cure. If, after a fair trial, this proves useless, the joint should be laid open and drained, any pendulous fringes being removed, or more thorough removal by arthrectomy should be performed. Great care must be taken to secure asepsis, and a useful movable joint may be obtained.

TUBERCULAR DISEASE OF THE SACRO-ILIAC ARTICULATION

Disease at the sacro-iliac joint is nearly always tubercular, and may begin in the joint cavity or in the sacral epiphysis. In the latter case the affection is more serious. Sacro-iliac disease usually occurs between the ages of fifteen and forty, but is not confined to this period of life.

Symptoms and diagnosis.—The disease is chronic, and steadily progressive; intractable sciatica is often the first indication of its presence. There is slight lameness and considerable pain, aggravated by movement or by forcible compression or attempted separation of the ilia. Direct pressure over the joint elicits pain, and is a valuable aid to diagnosis. The lower limb on the affected side may or may not be altered in position, the abnormal position suggesting the diagnosis of hip disease. The buttock is flattened from muscular atrophy. When suppuration occurs the pus may find its way into the pelvis, the iliac fossa, or posteriorly.

The diagnosis in the early stages is often difficult, and has to be made by excluding disease of the hip or lower regions of the spinal column. In hip disease there is fixity at the joint, with pain on movement and the characteristic position of the leg, while in spinal mischief the deformity about the column and the localised tenderness over the affected vertebræ are important diagnostic signs.

Prognosis.—Of late years the application to sacro-iliac disease of those principles of treatment which are applicable to a similar condition of other joints has very much improved the patient's chances of ultimate recovery, but at the same time sacro-iliac disease must be regarded as a very formidable affection.

Treatment.—Before suppuration has occurred, the disease may sometimes be arrested by absolute and prolonged rest; to ensure this the pelvis and upper parts of the thighs should be encased in bandages of liquid glass or starch, or by a properly fitted poroplastic apparatus. Blistering over the joint, or the use of the actual cautery, may be beneficial. When the tuberculous material is evidently breaking down, there should be no delay in resorting to operation. The steps of the operation are as follows:—The patient is rolled to the opposite side, and a semicircular flap, having its convexity corresponding to the posterior edge of the ilium, is dissected upwards and forwards; the glutei are detached, and the bone is exposed. It is now trephined at the root of the posterior inferior iliac spine. The joint is thus opened, and the entire cavity may be exposed by chiselling away as much bone as is necessary. The ilium may be separated from the sacrum by means of an elevator, so that any abscess cavity which may lie anteriorly is thoroughly exposed. The tuberculous material must be completely removed by scraping and flushing, and any sinuses which may be present are finally sharp-spooned. The area of the operation is treated with iodoform emulsion, the flap is replaced, and the wound closed; drainage is rarely necessary. In the subsequent treatment Golding Bird advises that the patient be encouraged to use the limb, no splint being applied while he is in bed, where he should remain for two months or more. When allowed up, the patient should wear either a Thomas's splint or a pelvic support, and should use crutches for some months.

TUBERCULAR DISEASE OF THE HIP JOINT

When the hip joint is attacked by tubercle, the disease usually begins in the bones at the points of most active growth. In the femur, the epiphysary line of the head, or of the great trochanter, or else the neck (Fig. 56, p. 164), are the points of attack; but if it begins in the acetabulum, the disease starts at the line of union of the three bones. The synovial membrane is sometimes the primary seat of the mischief, and in any case becomes involved later on. When the disease begins in the epiphysis of the great trochanter, the joint is not at first involved, but the morbid process may extend to it beneath the capsule; if the epiphysis of the head is the primary seat of mischief, it occasionally happens that the tubercular material does not escape into the joint, but, passing underneath the capsule, becomes extra-articular. When the bones are affected they are in a condition of caries, and the epiphyses may separate; necrosis of the pelvic bones may occur, and if the acetabulum is perforated intrapelvic abscess results. In most cases suppuration occurs, and the abscess burrows in different directions, influenced to some extent by the original seat of the disease. The acetabulum becomes partly obliterated by granulation tissue; and its margin being destroyed, the ligaments weakened, and the upper end of the femur carious, partial gradual dislocation ensues. The mischief in the upper end of the femur may extend into the medullary canal.

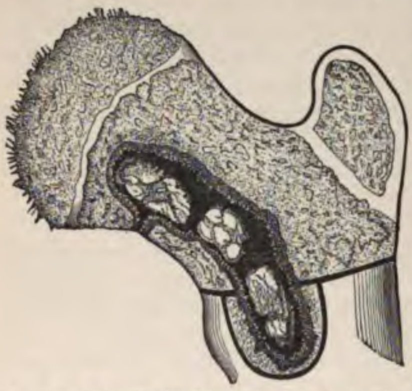

FIG. 56.—Tuberculosis of the neck of the femur with three sequestra. Secondary tuberculosis of the hip joint; the cartilage of the head of the femur has been destroyed. The dark lines show the extent of the operation of excision (Tillmans, after Volkmann).

Symptoms.—**Pain** varies considerably in degree, and may be only felt in the joint during movement, but it is usually referred to the inner side of the knee along the course of the obturator nerve. Pain in this region always suggests the possibility of hip disease, and must not be regarded as necessarily indicative of mischief in the knee joint. Pain may likewise be referred along the course of the sciatic or anterior crural nerves, both of which supply branches to the joint. It is increased by movement, especially by such as causes tension on the ligaments. When the bone is eroded, starting pains occur when the patient goes to sleep.

Lameness is due to the pain caused by movement, to spasm of the muscles, to increased rigidity of the joint, and to an alteration in the position of the limb. The patient walks with great care, using the spine rather than the hip, and bringing his foot down on the tips of his toes so as to bring its full elasticity into play, and thus avoid unnecessary jarring.

Position of the limb.—In the early stages of hip disease the limb is in the position of natural rest—that is, flexed, abducted, and rotated outwards, whereby the ilio-femoral ligament and the ligamentum teres are relaxed; the outward rotation especially relaxes the inner band of the Y-ligament and posterior part of the capsule. In endeavouring to compensate for this alteration of position the patient arches forwards the lumbar spine so as to overcome the flexion of the hip; abduction is compensated for by curvature of the lumbar spine towards the diseased side and consequent depression of that side of the pelvis, the degree of which is ascertained by noting the level of the two anterior superior iliac spines. This depression of the pelvis gives a false appearance of lengthening of the limb which can be readily disproved by measuring from the anterior superior iliac spine to the tip of the internal malleolus. At a later stage of the disease when softening and destruction of the ligaments occur, there is adduction and inversion of the limb; these are compensated for by a tilting of the pelvis and an arching of the lumbar spine to the opposite side, which produces apparent shortening. When destruction is still further advanced there is actual shortening, and should the head of the bone be drawn upwards out of the socket the limb will be in the position of dorsal dislocation (Fig. 57), and the top of the great trochanter will be found to lie above Nélaton's line, *i.e.* a line drawn from the anterior superior iliac spine to the most prominent point of the tuber ischii.

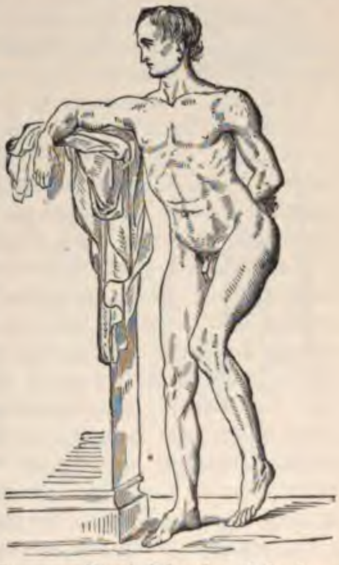

FIG. 57.—Dorsal dislocation of the femur secondary to hip disease (Fergusson).

Impaired movement occurs from spasm of the muscles and from voluntary fixation to minimise pain. During examination, an assistant should grasp the pelvis above so as to fix it, otherwise compensatory movements in the lumbar spine may deceive the surgeon. In arriving at a conclusion as to the amount of flexion possible, the limb must be slightly adducted, since it is already in a position of abduction. Rotation is always limited and causes considerable pain; if but little limited, the disease is probably extra-articular and affects the epiphysis of the great trochanter.

Muscular wasting.—The glutei are atrophied and wasted, and hence the fold of the buttock is diminished or lost, the muscles of the thigh become wasted, and all the atrophied muscles are flabby.

Swelling.—There is some fulness in the fold of the groin and also in the space behind the great trochanter. The inguinal glands may be tender and swollen.

Abscess.—Abscesses in connection with disease of the hip joint may burrow in different directions according to the part of the capsule which gives way. Usually the abscess presents to the outer side of Scarpa's triangle, and is most easily reached by the anterior incision described at p. 192. The pus may pass beneath the iliacus into the bursa which communicates with the joint; or, if the posterior part of the capsule gives way, subgluteal abscess forms; if the pelvic bones are diseased and the acetabulum is perforated, the pus passes into the pelvis beneath the obturator internus muscle and may be felt through the rectum; it may then pass upwards into the iliac fossa. The detection of suppuration may at first be difficult, but increasing pain and swelling with perhaps slight fever soon clear up the diagnosis. Even after apparent cure, when all signs of mischief about the hip have subsided, perhaps for many months, a residual abscess may form owing to the irritation caused by old inflammatory material which is thereby eliminated; such residual abscesses usually heal rapidly if treated by sharp-spooning as described in chap. iii. vol. i.

Prognosis.—If the case be recognised early and treatment by rest is carefully carried out for at least two years, there may be complete cure without suppuration, but even in such cases there is, as a rule, some degree of arrest or impairment of growth, and the limb, though good and useful and not deformed, is smaller than its fellow. In neglected cases and those in which treatment has proved of no avail, the patient may die of exhaustion, hectic, tubercular mischief in other organs, or from lardaceous or fatty degeneration. When suppuration has once occurred the prognosis as to the future utility of the limb must be proportionately guarded.

Treatment.—During the early stages the patient must be kept at complete rest and the limb immobilised by a Thomas's splint or weight extension. In applying Thomas's splint, it should at first be moulded to the position of the limb, and as inflammatory signs and muscular spasms subside, the position must be gradually corrected until the limb assumes that attitude which is ultimately required; forcible attempts at immediate reposition of the misplaced limb may do much harm and excite increased activity of the disease. If weight extension is employed, the patient should be placed on a fracture-bed, the foot of which should be raised. The weight must be proportioned to the age of the patient, and, if necessary, a Liston's long splint may be applied to the sound side in order to keep the patient in the required position. The patient lying with the transverse axis of the pelvis (measured from one anterior iliac spine to the other) at right angles to the median plane of the body, traction should at first be made in the direction of the axis of the displaced femur, the lordosis being first overcome; as the treatment is continued, it will be found possible to gradually bring the limb down to its normal position without reproducing the lordosis or tilting the pelvis. Treatment by weight extension should only be employed so long as there is pain; as soon as this disappears, the patient should be placed in a Thomas's splint, which allows him to get up and go into the open air. In little children who cannot use crutches, a double Thomas is the best, but older ones should have a single splint and get about on crutches. Treatment by this method must be persevered in for six or twelve months, or even longer. When suppuration occurs the abscess must be freely opened and its walls treated in the manner described in chap. iii. vol. i. If all attempts to save the joint are futile, excision must be performed (see p. 192). Finally, amputation may be necessary if, after an excision, the wound will not heal and sinuses form in various directions, and the patient begins to show evidence of failing strength from hectic and amyloid disease. Amputation permits of free drainage, and of local treatment for the acetabular and pelvic disease.

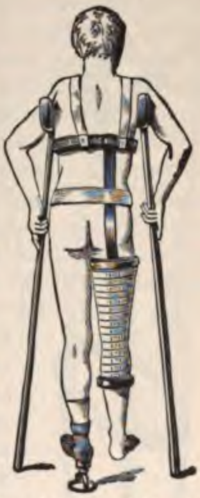

FIG. 58.—Thomas's hip splint applied with a patten on the sound side (Berkeley Hill).

TUBERCULAR DISEASE OF THE KNEE JOINT

The knee joint is very commonly the seat of tubercle, the disease originating in the synovial membrane, in the ends of the bones, or in the epiphysary line. The progress of the disease is chronic; there is little or no pain until the bone ends have become carious and the tubercular tissue is breaking down; when the bone is the primary seat of attack the pain occurs early and is more severe. There is a certain degree of stiffness about the joint, and the patient walks with a slight limp, bringing the elasticity of the foot into play by walking chiefly on his toes. The joint is swollen, the swelling obliterating the depression on each side of the tendo patellæ and mapping out the upper pouches of the capsule; such swelling is doughy and elastic, since it is due to the thickening of the synovial membrane and periarticular tissue and not to fluid. In cases of primary synovial disease there may be considerable effusion of fluid in the joint; this may subside under treatment by rest, only to be followed by reaccumulation and subsequent white swelling. The muscles of the limb are wasted, and hence the swelling of the joint appears greater than it really is. The joint is slightly flexed, the degree of flexion steadily increasing with the progress of the disease unless means be taken to prevent it; owing to the muscular contraction and softening of the ligaments backward dislocation with external rotation may ensue. The surface temperature is not increased, nor is the skin red (*white swelling*). Under appropriate treatment the disease may subside, or the tubercular tissue may degenerate and softened patches be detected. When degeneration begins and the bones become carious, starting pains occur in the limb when the patient tries to sleep, and unless these be prevented by weight extension, his general health suffers on account of pain and broken rest. The starting pains are due to the fact that, when awake, the patient keeps guard over the movements of his joint by muscular contraction; on his going to sleep some slight movement occurs and the partially relaxed muscles, suddenly contracting, move the inflamed joint surfaces upon each other. When abscess has occurred

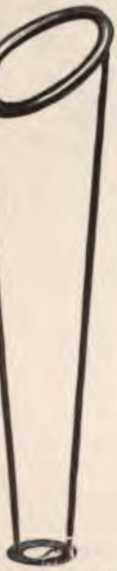

FIG. 59.—Thomas's knee splint (Berkeley Hill).

sinuses are formed in the soft parts. The course of the disease varies from a few weeks to many months.

Treatment.—The joint must be immobilised by a Thomas's knee splint, and complete rest must be ensured for some time after all signs of mischief have subsided. Should there be any flexion of the joint the limb must be put up in this position, but as the muscular contraction is gradually overcome, it should be gradually restored to the normal. Weight extension may be employed instead of a splint. It is of extreme importance that any flexion or partial backward displacement of the leg should be overcome, so that should ankylosis take place the limb may be a useful one. Counter-irritation by means of blisters is sometimes beneficial, or one or other of the procedures detailed at p. 160 may be adopted. As soon as degeneration and breaking down occur, some operation becomes necessary, arthrectomy, excision, or amputation being performed according to the circumstances of the case.

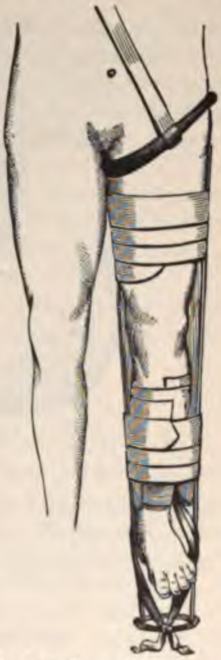

FIG. 60.—Thomas's knee splint applied (Berkeley Hill).

TUBERCULAR DISEASE OF THE ELBOW JOINT

Tubercle of the elbow joint is essentially a disease of early life; Watson Cheyne states that 66 per cent of the cases occur between the ages of ten and twenty. The disease usually begins in the bone, chiefly in the olecranon process or one of the condyles, sometimes in the head of the radius. When degeneration and abscess occur the pus may remain extra-articular and point externally; or, if the joint cavity is invaded, the pulpy granulation tissue fills it and causes swelling on each side of the tendon of the triceps. Such swelling eventually becomes more uniform and appears greater than it really is on account of muscular wasting; the forearm is slightly flexed and pronated (Fig. 61, p. 170). Movement is but little affected during the early stages of the disease, nor is there much pain.

Treatment.—If the case is seen quite early and the disease is limited to one part of the bone, *e.g.* the olecranon, it may be completely eradicated by careful sharp-spooning. The limb should be put up at a right angle, the forearm being kept midway between pronation and supination. When the joint cavity is involved, arthrectomy gives a good result in children, but excision should be performed in adults (compare Fig. 61 with Fig. 74, p. 198). Amputation is only necessary in neglected cases.

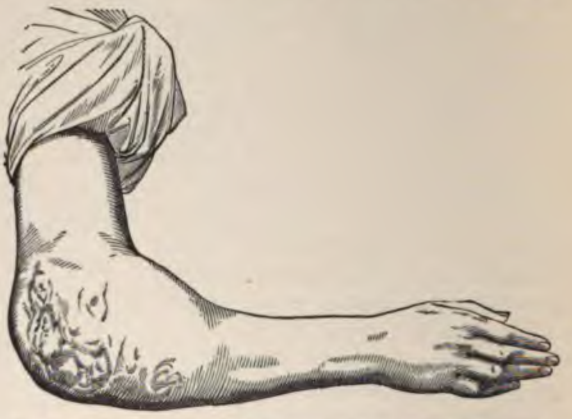

FIG. 61.—Tubercular disease of the elbow joint of a boy; compare with Fig. 74, p. 198 (Fergusson).

SYPHILITIC AFFECTIONS OF THE JOINTS

AFFECTIONS DURING THE SECONDARY STAGE

Syphilitic arthralgia.—In the early stages of syphilis, even before the appearance of the rash, the patient may experience pain of an intermittent character in the joints. The larger joints, especially the knee and shoulder, are most usually attacked, but sometimes the smaller ones alone suffer. One joint only may be affected, but the pain is usually polyarticular, lacking however the metastatic character of true rheumatism. Bone and muscular pains are frequently present. The joint pains are but slight during the day and diminish with movement, but at night may be very severe, and even agonising. There is no fluid, nor are there any objective signs or constitutional disturbance traceable to the joint lesion, which is apparently simple hyperæmia of the synovial membrane and ligaments, with some effusion of lymph on the surface. Fever, if present, is merely that met with in early secondary syphilis when the exanthem makes its appearance. The duration of the pain varies, in some cases quickly subsiding under mercurial treatment, in others lasting for a long time.

Syphilitic hydrarthrosis occurs during the early secondary manifestations within a few months of infection, and affects the knee more usually than any other joint, but the ankles and elbows are not infrequently affected, and no joint is exempt. The onset is insidious, usually painless, and unaccompanied by constitutional disturbance. The amount of fluid varies in different cases, and also from time to time in the same case; as a rule it is slight. As the effusion comes on there is some small degree of stiffness and limitation of movement, and there may be slight pain at night. There is no tendency to suppuration. The duration of the disease, like that of the arthralgia mentioned above, varies, and recurrence is not uncommon.

Treatment.—That of secondary syphilis, coupled with Scott's dressing to the joint (p. 160).

AFFECTIONS DURING THE TERTIARY STAGE

Perisynovial gummata or gummatous synovitis may occur many years after inoculation, and always runs a very chronic course. Similar conditions are also met with in congenital syphilis.

Morbid anatomy.—The disease may begin in the subsynovial tissue, or in the fibrous and tendinous periarticular structures. In the latter case the joint cavity may never be implicated, or else gradual extension to the synovial membrane may ensue. The progress in all cases is chronic, and may take months. Gummatous tissue is deposited in the affected parts, gradually extending until the joint may be occupied by a mass of pulpy, poorly vascularised tissue resembling that seen in tuberculous synovitis (syphilitic pseudo-white swelling of Richet). There is, as a rule, but little fluid effusion.

As the disease progresses the cartilages may be slowly eroded and the bones affected; osteoplastic periostitis occurs at the articular margins. More usually, under treatment, the new tissue undergoes gradual absorption and partial organisation, leaving some slight thickening and impairment of motion.

If nutrition fails, the gummatous material softens, and causes destruction of the joint; or, if situated in the periarticular structures, the softened gummata open upon the surface, and eventually cicatrise or implicate the joint cavity.

Symptoms.—The onset is very gradual, and marked at first merely by slight pain and stiffness, with some limitation of movement. Swelling of a brawny, elastic nature is soon evident; the swelling may be distinctly nodulated, and masses of thickened synovial membrane may be felt moving in the joint cavity, which contains a little fluid. As the swelling increases pain becomes more persistent and severe, especially at night. When destruction occurs, softened patches become evident, and the skin over them reddens and gives way; or, if the synovial membrane is affected, signs of erosion of cartilage make their appearance. The knee is attacked in preference to any other joint, but the elbow or ankle sometimes suffer.

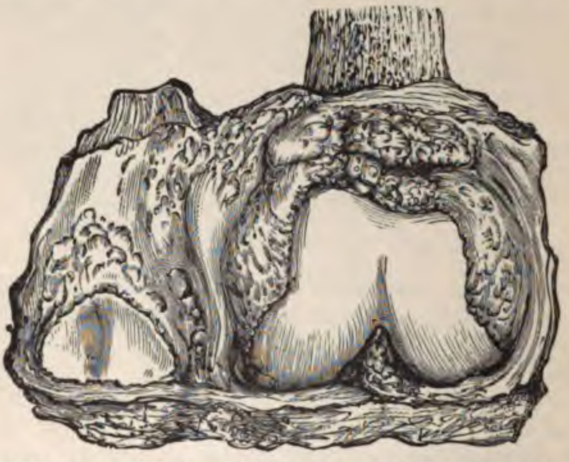

FIG. 62.—Syphilitic disease of the knee joint. The subsynovial tissue, thickened and tuberose from gummatous exudation, bulges the synovial membrane itself towards the cavity of the joint. The lower end of the femur is inflamed and roughened (Howard Marsh, St. Bartholomew's Museum, No. 567A).

Diagnosis.—Syphilitic gummatous synovitis resembles in its general progress the tubercular affection, but may usually be distinguished by its occurrence in persons exhibiting other and unmistakable evidences of syphilis, by the nodular character of the swelling and the more constant effusion of fluid, and by the marked tendency to cure under appropriate treatment. If destruction occurs the gummata, bursting on the surface, have a characteristic appearance (see p. 176, vol. i.).

Treatment.—The joint should be put up in some retentive apparatus, such as liquid glass or plaster, after having been enveloped by strips of lint smeared with the compound mercurial ointment. Iodide of potassium or sodium, combined with the biniodide of mercury and vegetable bitters, must be persevered with.

Even when gummata have broken down, and have discharged on the surface, healing will occur under this treatment.

Syphilitic joint disease secondary to osteitis.—In rare cases a gummatous deposit beneath the periosteum or in the end of the bone may be associated with chronic inflammation of and effusion of fluid into the neighbouring joint. Such a condition is very liable to be mistaken for one of new growth, and unless the patient present unmistakable evidences of syphilis the diagnosis may necessitate an exploratory operation and careful microscopic examination. Severe aching pain at night is suggestive of the syphilitic affection.

GOUTY ARTHRITIS

Gouty arthritis is characterised by a deposit of acicular crystals of urate of soda in the cartilages, bones and fibrous tissues, and to a less extent in the synovial membrane. The synovium is loaded with the salt which, being precipitated from it, accumulates in and may fill the joint. Owing to the resultant chronic inflammation the synovial membrane and its fringes overgrow and become pendulous, the condition being often aggravated by associated osteoarthritis. The cartilages may be slightly eroded, but still persist. The periarticular fibrous structures and tendons may be the seat of chalky concretions (*tophi*), which by pressure cause ulceration of the overlying skin with suppuration.

The distribution of the gouty change is determined in great part by the poorness of the vascular supply and the remoteness

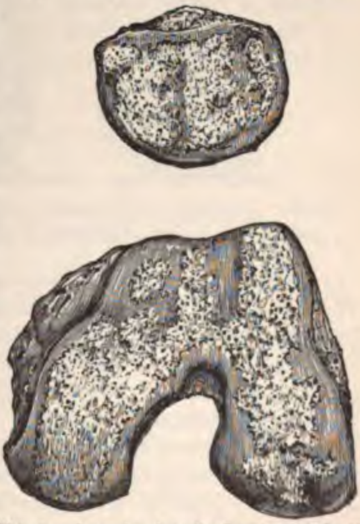

FIG. 63.—Irregular deposit of urate of soda on the condyles of the femur and on the patella (Howard Marsh, St. Bartholomew's Museum, No. 708).

from the heart; thus the fingers and toes especially suffer, although no joint is exempt.

Symptoms.—As the disease is often associated with chronic osteoarthritis, the symptoms of that condition may predominate. The joint is enlarged and painful, and there may be nodular deposits round it; there is little or no effusion, unless an acute attack supervenes. Acute gout usually attacks the metatarso-phalangeal joint of the big toe, probably because it is subjected to the greatest pressure during walking; the attacks begin in the small hours of the morning, and are characterised by great pain, swelling, heat, and redness, accompanied by irritability of temper. After a few days the acute symptoms subside, to be followed at uncertain intervals by similar attacks.

Treatment.—The general treatment of gout comes within the province of the physician rather than the surgeon, and the reader is referred for a full account of the disease to a work on Medicine. Careful dieting, regulation of the bowels, promotion of the functions of the skin and kidneys, and the exhibition of alkalies and colchicum are the main indications. During an acute attack the joint should be wrapped in cotton wadding, and elevated; the diet must be simple, and the bowels freely acted upon by salines in combination with colchicum. As the pain subsides gentle massage should be employed.

OSTEO-ARTHRITIS

Syn. Chronic rheumatic arthritis—Arthritis deformans—Dry rheumatic arthritis—Rheumatic gout—Rheumatoid arthritis—Malum senile articulorum—Poor man's gout.

Etiology.—Rheumatoid arthritis is essentially a disease of middle age and advanced life, and is often hereditary. In old people it usually attacks the larger joints, especially the hip and knee, and may at first remain limited to one or two joints only (monarticular form), whereas in the earlier years the smaller joints, especially those of the hand, chiefly suffer (polyarticular form). Women are somewhat more prone to the affection than men, and it occurs among the poor more frequently than the well-to-do. Mental and physical influences of a depressing nature, whereby the general health is depreciated, bad and insufficient food, and faulty hygienic surroundings, are important causative factors. Cold and damp are especially injurious, not only producing the disease but increasing its severity.

The subjects of rheumatoid arthritis have frequently suffered from chronic rheumatism, and sometimes from gout—gouty changes are not infrequently met with in rheumatoid joints. The onset of the disease is frequently attributed by the patient to injury.

Pathology and morbid anatomy.—The pathology of rheumatoid arthritis is shrouded in obscurity. According to some (and this is perhaps the most usually accepted theory), it is a general constitutional disease of the nature of ordinary rheumatism, perhaps with a gouty epiphenomenon. Others attribute it to a disordered state of the nervous system leading to failure of nutrition of the muscles, ligamentous structures and joints. The changes occurring in the joints are practically the same in the monarticular and polyarticular forms. In many cases the disease is so insidious in its onset and course that it is well established before the patient applies for relief; in others subacute attacks of inflammation, accompanied by swelling of the synovial fringes and fluid effusion into the joint occur; after a time the fluid is absorbed, and the disease runs a chronic course. If the joint be examined the following changes will be found:—

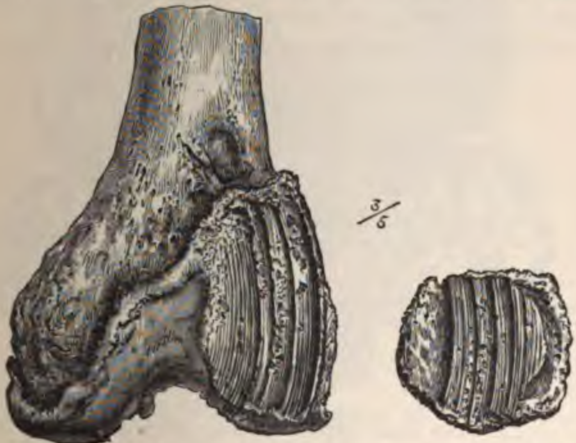

FIG. 64.—Grooving of the cartilages of the femur and patella in osteo-arthritis (Howard Marsh, St. Bartholomew's Museum, No. 698).

The articular cartilages, in which the morbid process appears to begin, lose their smooth shiny appearance; the cells multiply and degenerate, and, on the capsules rupturing, are cast into the joint; the matrix undergoes a fibroid change, and tends to split vertically

As a result of these changes the cartilage surface is pitted and roughened and acquires a velvety appearance. At the points of greatest pressure the cartilage atrophies; at the margins it hypertrophies. The atrophic change leads to a wearing away of the cartilage and exposure of the bone which, in consequence of long-continued slight irritation from attrition, becomes the seat of sclerosis. Lime salts are deposited in the cancellous spaces, so that the bone is rendered extremely hard and dense by the new porcelain-like deposit. Continued friction and attrition cause wearing away of the bone in spite of its density, and the surface, presenting ridges and furrows parallel with the plane of movement, receives an ivory-like polish (*eburnation*, Fig. 64, p. 175).

At the margin of the cartilage there is increased growth in the form of nodular masses, which subsequently ossify. These outgrowths closely resemble the gutterings of a tallow candle, and bear a marked contrast to simple inflammatory osteophytes, being more rounded and smooth. In consequence of this new bony formation, the articular surfaces are much broadened and deepened; and by the mechanical impediment they offer, movement in the joint is much restricted. Pseudo-ankylosis results in bad cases; but there is no true ankylosis due to fusion of the bones.

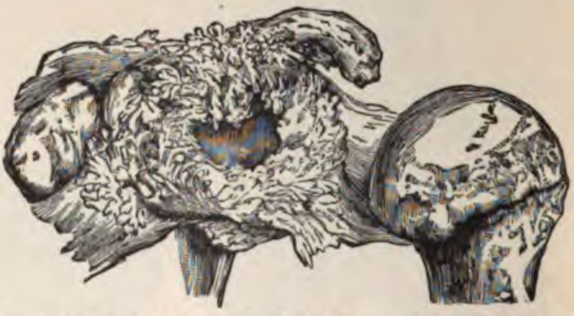

FIG. 65.—Osteo-arthritis of the shoulder joint, in which the synovial membrane is studded with tufts, many of which contain nodules of cartilage (Howard Marsh, St. Bartholomew's Museum, No. 666).

The synovial membrane is much thickened—the fringes become pendulous, often club-shaped, and of considerable length, and may contain cartilaginous or osseous nodules (Fig. 65). In some cases the synovial membrane, if placed in water, resembles an open sea-anemone.

Cartilaginous and osseous nodules may form in the fringes, and may become detached during movement of the joint, and form loose bodies. The ligaments are thickened and contracted, and may be the seat of calcareous deposits. Interarticular ligaments and cartilages may be completely absorbed. The articular ends of the bones beyond the area of porcellaneous deposit are atrophied, and, yielding to pressure, increase the deformity met with in the disease. This is well seen in the hip (Fig. 66). Suppuration is of great rarity. In advanced cases bony outgrowths are met with on the bodies of the vertebræ, and the common ligaments may be completely ossified in some situations. Accompanying the arthritic changes the muscles acting on the joint undergo atrophy, and may be displaced, or calcareous masses may be present in them especially at their insertions.

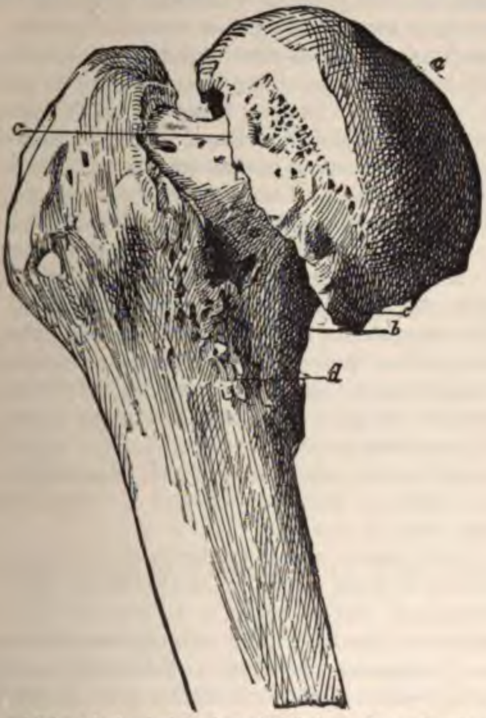

FIG. 66.—Osteo-arthritis of the head of the femur (Ziegler). *a*, flattened and eburnated articular surface; *b*, neck of the femur; *c*, overhanging rim of the head; *d*, osteophytes along the intertrochanteric line.

Symptoms.—In most cases there is a history of subacute recurrent attacks of synovitis with fluid effusion; but these attacks have never quite cleared up, and the chronic condition has gradually supervened. In other instances no such attacks have occurred, and the patient's attention has been directed to the joint in consequence of pain, tenderness, and stiffness, with some limitation of movement. These signs may be attributed to some antecedent injury, from which the patient states the joint has never recovered. Usually, there is no fluid present; but sometimes there is a considerable quantity. The pain is often severe and constant, being worse at night, on movement, or during damp and cold weather. Stiffness gradually becomes more marked, and limitation of movement, or, in bad cases, complete immobility results. This pseudo-ankylosis may effectually prevent the patient walking, sitting, or performing the most simple movements. Examination of the joint in the early stages shows the presence of creaking due to the roughened state of the cartilages; later on, when the bones are exposed, crackling and grating are present. The marginal outgrowth causes marked enlargement and deformity, the precise nature of which varies considerably. Under favourable conditions the disease may make but little progress, but in the worst cases the joints are permanently fixed, and the patient is reduced to complete helplessness.

The general health may remain good, or anæmia and debility, partly due to continued pain and partly to the confinement entailed by the disease, may be present.

As a rule the disease runs a gradually progressive course, especially in the case of those whose financial position debars them from proper treatment.

Treatment.—The most that can be expected from treatment is alleviation of symptoms and delay in the progress of the malady.

Locally, the affected joints must be protected from cold by wrapping them in cotton wadding or flannel. Passive motion and douching, or friction with some stimulating liniment counteract to some extent the increasing tendency to stiffness and pseudo-ankylosis. If movement causes much pain, rest is the better treatment.

Turkish baths, or those of Buxton, Bath, Droitwich, Harrogate, Wiesbaden, Aix-les-Bains, Aix-la-Chapelle, Baden, and other well-known resorts, are very beneficial, but unfortunately are beyond the means of many patients. Residence in a warm, dry, and equable climate is also advisable, and patients whose position enables them to enjoy the advantage of treatment at the places mentioned, should arrange for their stay at any particular place during the most favourable season. Treatment by the hot-air bath is always worthy of trial, and sometimes gives surprisingly good results.

Local anodynes may become necessary if pain is severe; the best for this purpose is the linimentum opii.

The chief drugs which have been found of service in rheumatoid arthritis are arsenic, syrupus ferri iodidi, iodide of potassium, and guaiacum. Of these arsenic is the most useful, and may be given in combination with the iodide of iron, or in the form of Levico water. Iodide of potassium is depressing, and should be avoided if the patient is old and anæmic.

In some cases I have found marked benefit from the use of Piperazin water; this may be conveniently taken as an effervescing water at meal times. Lithia water is also useful.

Salicylates are useless in the chronic disease, but may be productive of good in those subacute attacks which often occur in the early stages, and which cause so much pain.

General nutrition should be encouraged by the use of cod liver oil or maltine, preference being given to that which the patient can more easily digest. The diet must be good and nutritious. Fish, poultry, meat in moderate quantities, and green vegetables may be taken, but pastry, sugar, and starchy food should be interdicted.

If stimulants are taken, whisky or Hollands gin of sound quality are the best, malt liquors and generous wines must be studiously avoided.

TABETIC ARTHROPATHY—CHARCOT'S JOINT DISEASE

Charcot was the first to describe certain changes occurring in the joints of persons affected by locomotor ataxy. Very similar changes are also met with in cases of syringomyelia (p. 240).

Pathology and morbid anatomy.—Some observers have sought to establish the identity of Charcot's disease with rheumatoid arthritis, the presence of the spinal cord disease being held responsible for the marked divergence of the joint affection from that commonly seen in rheumatoid arthritis. It is impossible, however, to admit such an identity in view of the many and weighty evidences against it. The points of contrast clearly indicating the distinct individuality of the two joint affections will be readily perceived when their leading characteristics are contrasted.

The essential cause of the joint lesions is matter for further investigation. By some it is thought to be dependent on peripheral neuritis, and it is pointed out that perforating ulcer with changes in the peripheral nerves is not an uncommon accompaniment of the joint affection. Dr. Buzzard has advanced the hypothesis that there is some interference with a supposed joint centre situated in the medulla, and, in support of this view, points to the great frequency of gastric, intestinal, and laryngeal crises in those cases of tabes in which the joint affection is present. This view must at present be regarded as hypothetical only, as no pathological evidence has been adduced in its support. Morrant Baker suggested that rheumatoid arthritis, tabes dorsalis, and Charcot's joint disease are so many evidences of a widespread general disease—at one time the joints are the seats of the morbid process (rheumatoid arthritis), at another, the posterior columns of the cord (tabes dorsalis), and, lastly, both may be affected (tabes dorsalis with Charcot's joint disease). This hypothesis, however, implies the practical identity of rheumatoid arthritis with Charcot's arthropathy.

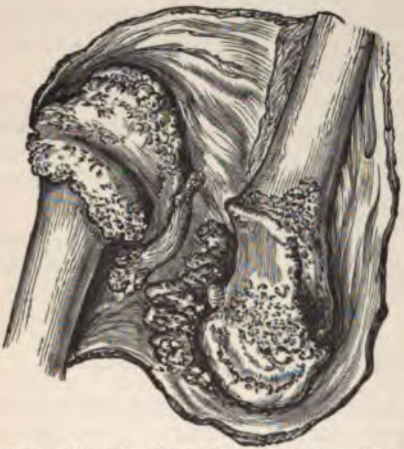

FIG. 67.—Charcot's disease of the right knee joint, from a case under Morrant Baker. The external condyle of the femur has almost disappeared; it is represented by two nodules of bone embedded in the thickened synovial membrane. The internal condyle is flattened laterally, and deeply grooved from contact with the head of the tibia, the inner part of which is completely worn away, the outer part taking the place of the lost external condyle. In the drawing the bones are represented separated. The line of the articulation was, consequent on these changes, nearly vertical instead of horizontal. The exposed bone is mostly smooth and hard, but in places the cancellous tissue is exposed, as in caries (Howard Marsh, St. Bartholomew's Museum, No. 691B).

The enormous amount of fluid which these joints sometimes contain leads to distension or relaxation of the capsule and ligaments, and fills the bursæ communicating with the articulation. Fluid is also met with in the periarticular structure. The synovial membrane is thickened, and the fringes are hypertrophied. The cartilages and bones undergo rapid atrophy leading to dislocation, which often occurs suddenly and early in the disease. Osteophytic outgrowths are not a marked feature of the disease, but in some cases they are considerable and cause deformity. Spontaneous fracture of the atrophied bones is not uncommon.

Symptoms.—The joint affection usually makes its appearance after the prodromal symptoms of tabes have become manifest, but before incoordination is present. If, as sometimes happens, a joint is affected late in the disease it is usually one of those of the upper limb, since the degenerative changes in the cord affect the tracts corresponding to the upper limbs later on. As a rule, the joints of the limbs which have recently developed ataxic symptoms are those most affected.

The joints usually attacked are, in order of frequency, the knee, hip, shoulder, and elbow, the knee being attacked as frequently as all the other joints put together.

Preceding the actual onset of the mischief, which is sometimes attributed to injury, some crackling may have been noted in the joint. In most cases the onset is very sudden, but in some it is gradual; the committee appointed by the Clinical Society to investigate the nature of this disease found a gradual onset in twenty-three out of seventy-nine cases. There is enormous swelling from fluid effusion within the capsule, which comes on without pain or obvious cause, in the space of twenty-four hours. This effusion may as rapidly be absorbed, only to re-accumulate and be followed by destructive changes. The periarticular structures are the seat of engorgement and fluid effusion without œdema, although in rare cases this is present. Pain is usually absent from the first, but if present it quickly passes off, and the subsequent course of the case is painless. There is increased and abnormal mobility due to rapid atrophy and wasting of the articular ends, coupled with distension of the capsule and relaxation of the ligaments. The looseness of the joint is accompanied by crackling sensations on movement. Dislocation rapidly ensues, sometimes as early as the first week, and usually within two or three months.

Sometimes there are irregular and ineffectual attempts at repair, and numerous osteophytes are thrown out, causing considerable enlargement and deformity of the bone ends. Suppuration does not occur.

The muscles of the limb and in the neighbourhood of the joint rapidly waste, and this still further increases the feeling of insecurity and uselessness.

Treatment.—No treatment of a curative nature is possible. Aspiration of the joint is soon followed by re-accumulation of the fluid. The best course to pursue is to support the joint by some apparatus, or else by starch or other immovable support which will enable the patient to use the limb as freely as possible. When a joint is completely disorganised and no apparatus acts efficiently, amputation may be performed provided the patient's general condition is good, the tabes not advancing, and the presence of the useless limb a source of considerable inconvenience and annoyance.

CYSTS IN CONNECTION WITH JOINTS OR ASSOCIATED WITH JOINT DISEASE

In cases of hydrarthrosis, from whatever cause arising, a bursa in communication with the synovial cavity may become distended with fluid, or a cyst may result from a hernial protrusion of the synovial membrane. Cysts of this nature sometimes extend a considerable distance between the muscles, and are connected with the joint by so narrow a neck that, on superficial examination, they appear to be independent of it. When the limb is straightened, tension is raised in the cyst which is thereby made more evident, but becomes lax again, or may completely disappear when the joint is flexed. The cyst is elastic, fluctuating, variable in tension according to the position of the joint, and quite painless; the diagnosis is usually easy; but in some cases, when the cyst is united to the joint by a long neck, its real origin may be overlooked. The semimembranous bursa at the knee is often the seat of this condition.

D'Arcy Power has pointed out the diagnostic importance of bursal enlargements in the neighbourhood of joints which may subsequently become tubercular; and similar disease may affect the synovial tendon sheaths, especially at the wrist joint. When such cystic enlargements are brought under notice there may be no signs indicative of joint mischief, and the cyst itself is cured by incision or scraping. In such cases the relief may be only temporary, the patient returning after weeks or months with undoubted disease of the joint itself, which has been set up, in some cases at least, by direct invasion from the tuberculous bursa.

Treatment.—Aseptic excision performed with the greatest care is the best treatment for simple cases; blistering, aspiration, and pressure may be of temporary service, but fail, in the great majority of instances, to permanently benefit the case. In performing excision it must be remembered that the cyst probably sends numerous expansions between the adjacent muscles, and the surgeon should allow himself plenty of room so as to avoid wounding the surrounding structures; the neck of the cyst, where it penetrates the capsule, should be ligatured with chromic catgut. Tubercular diseases of a bursa should be treated by excision; of a synovial sheath by free drainage, or sharp-spooning according to circumstances.

LOOSE BODIES IN JOINTS

Loose bodies are far more commonly met with in the knee than in any other joint, but they may also occur in the elbow, shoulder, or hip, and, very rarely, in other joints.

They may be single or multiple, and are usually flattened and oval in shape, varying in size up to that of a small walnut. In structure they vary according to their origin.

Causes.—Foreign bodies may be the result of injury, inflammation, or new growth.

Traumatic foreign bodies are usually single and may arise in one of the following ways:—

(1) A portion of articular cartilage may have been chipped off in consequence of injury, *e.g.* a penetrating wound.

(2) A portion of cartilage and bone may be contused and become separated by a process which has been designated Quiet Necrosis (p. 137).

(3) A portion of foreign material may have entered the joint from without.

(4) A mass of fibrin may separate from blood-clot.

Inflammatory foreign bodies are often numerous and may arise—

(1) By separation of hypertrophied synovial fringes which may have become cartilaginous or osseous.

(2) As masses of inflammatory fibrin.

(3) In osteoarthritis bony masses may be found free in the joint, being broken off from the osteophytes at the articular margins, or originating in ossification of the hypertrophied fringes.

Neoplastic foreign bodies.—Some cartilaginous and osseous foreign bodies doubtless have their origin neither in injury nor inflammation, but must be regarded rather as tumour formations, beginning in the cartilaginous nodules normally present in the secondary fringes of Rainey; Fig. 68, p. 184, represents bodies of this nature removed from an otherwise healthy knee joint.

Signs.—A foreign body may be present in a joint without causing any symptoms. In the knee the patient's attention is usually drawn to the condition in a sudden and unmistakable manner. While walking he is seized with sudden, often excruciating pain, causing him to feel sick and faint, or actually to fall. The joint is semi-flexed, but can easily be straightened. The pain is dependent upon sudden stretching of the ligaments, the foreign body having slipped between the articular surfaces during movement.

So long as it remains in this position the joint must be semi-flexed, but it usually at once slips aside and extension is permitted.

Following such a seizure, there is a mild attack of synovitis. Similar seizures, followed by synovitis, occur from time to time, the intervals between the attacks often becoming shorter, and the resulting synovitis being more severe and lasting longer until eventually it becomes chronic. The patient may himself have detected the foreign body; but although its presence is certain, from the history of the attacks, it is not always easy to find, and many examinations may be required.

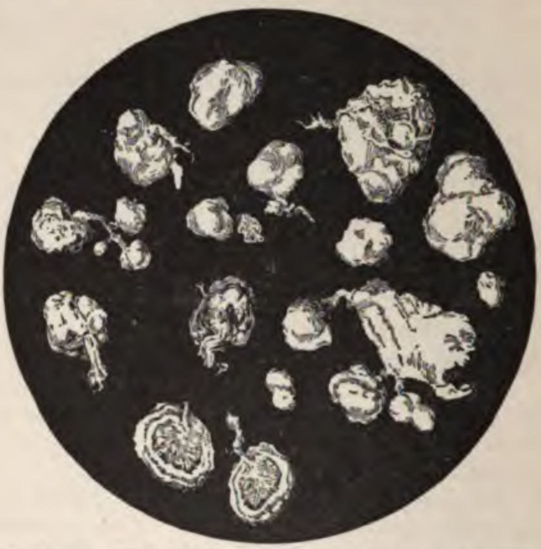

FIG. 68.—Foreign bodies (natural size) from a knee joint They are partly osseous, partly cartilaginous, and were attached to the synovial membrane by slender pedicles. They arose in the fringes as new cartilaginous growths which have undergone partial ossification (Westminster Hospital Museum, No. 371A. Drawn by C. H. Freeman).

The signs closely resemble those met with in displacement of the semilunar cartilages. The differential diagnosis depends upon the detection of the foreign body, and the fact that in the latter the pain is fixed, and a depression may be felt near the head of the tibia (see p. 202, vol. ii.).

Treatment.—After an attack the synovitis must be treated by rest, and the application of the ice-bag. Subsequent attacks may possibly be prevented by the application of a properly fitting knee-cap, limiting the movements of the joint. Sometimes, though rarely, this results in cure, the foreign body being localised by adhesions. In most cases the body should be removed, and the patient permanently cured; but if rheumatoid arthritis is present, no operation should be undertaken; moreover, in such cases the patient may suffer but little inconvenience, owing to the fixity of the joint resulting from the disease.

The operation is thus performed:—

The joint and adjacent parts of the thigh and leg having been thoroughly cleansed and rendered aseptic, the foreign body is, if possible, brought to the outer side of the joint, and held in position by a needle thrust into it. This is, however, by no means always possible, but is very desirable, as thereby less damage is inflicted, and the risk of inflammation is much lessened.

An incision of sufficient length to give free access to the joint is made through the skin, and the capsule of the joint opened to the same extent. If the foreign body has been previously secured, it can now be readily removed; if not, the finger is introduced and the joint searched until the body is found and removed. The cavity should be well flushed with 1 : 20 carbolic, and the capsule then sutured with chromic gut. The skin wound is closed with horsehair, and a dry antiseptic dressing applied, the limb being fixed on a back splint and complete rest enjoined for a fortnight. At the end of a week the dressings and stitches may be removed, and a dry collodion dressing applied.

If much chronic synovitis is present it may be advisable to drain the joint, but this is rarely necessary.

After the operation the patient will be well advised to wear a knee-cap of elastic webbing for six months.

ANKYLOSIS OF JOINTS

When the opposed articular surfaces become united as the result of morbid changes in a joint, it is said to be ankylosed. The uniting bond may be fibrous tissue or true bone, its nature depending in great measure upon the degree of destruction of the articular surfaces which preceded the ankylosis. When repair occurs in an inflamed joint—provided the inflammation has been severe—new fibrous scar tissue is developed, as in a similar process occurring in the soft parts. The fibrous tissue thus formed unites the opposed surfaces, and limits or arrests movement according to the density of the union. Limitation of movement is further increased by thickening of the periarticular structures. If the bony surfaces have been denuded by the morbid change, they unite in the same way as do the fragments in a fracture, and bony ankylosis results (Fig. 69). Fibrous ankylosis varies considerably in degree; it may be very complete, or consist only of a few adhesions, which can be readily broken down, and movement thus restored. The ligaments, muscles, and soft structures in the neighbourhood of the ankylosed joint are shortened, contracted, and altered in position according to that which the joint assumes. These changes offer a further bar to curative treatment. When there is no movement whatever in the joint, the ankylosis is said to be complete, otherwise it is partial. It sometimes happens, especially in old age, and in the vertebræ of rheumatic patients, that ankylosis results from partial or complete ossification of the ligaments, without any apparent inflammatory changes in the bones themselves. In such cases the new bony tissue takes the exact shape of the ligament it represents.

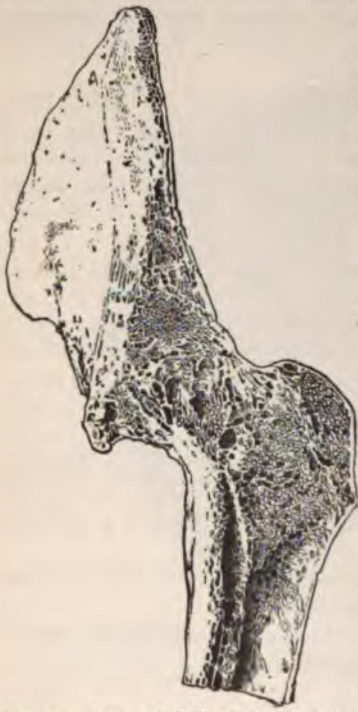

FIG. 69.—Bony ankylosis of the hip joint. The bones are considerably atrophied; the compact layer is diminished in thickness, and the cancellous spaces are larger than normal (Westminster Hospital Museum, No. 362. Drawn by C. H. Freeman).

Diagnosis.—The degree of fixity is often apparently greater than it really is in consequence of resistance on the part of the patient due to pain. In such cases the real degree is only discoverable under anæsthesia. Fibrous ankylosis may be as complete and dense as bony, the differential diagnosis depending on the presence of pain on attempted forcible movement in the former, and its absence in the latter. Want of mobility, due to periarticular changes, may be differentiated from true ankylosis by the history of the case, which will indicate the probable cause of the mischief.

Pseudo-ankylosis—Temporary fixity.—In false ankylosis the movements of the joint are limited, but there is no fusion of the articular surfaces. When a joint has been kept at rest for a long time, especially if this period of rest has been necessitated by inflammation of the joint or periarticular structures, there is always a variable degree of stiffness and temporary fixity due to shortening of the muscles and ligaments, and the organisation of effused lymph in the soft structures. Fractures involving joints may similarly lead to loss of mobility; and in some cases callus is thrown out, and fills up the natural depressions of the articular ends, causing more or less complete fixity. This is well seen in cases of fracture implicating the lower end of the humerus, the olecranon and coronoid fossæ being filled with callus. Mobility is restored as soon as this becomes absorbed (see p. 154, vol. ii.). In rheumatoid arthritis there may be complete fixity of a joint from interlocking of the osteophytic outgrowths and changes in the joint surfaces, but there is no true ankylosis due to fusion. Muscular spasm due to bruising, hysteria, or early joint disease may cause much limitation of movement, which latter is, however, perfect when the patient is fully anæsthetised.

Treatment.—Temporary stiffness of a joint from long disuse, or inflammation of the periarticular structures, can be readily overcome by a course of douching, massage, and passive motion, the patient being encouraged to use the joint as much as possible. When, from the very nature of the case, it is probable that ankylosis will result, the joint should be placed in that position in which it will be most serviceable should this occur. If ankylosis is dependent upon adhesions within the capsule, the articular surfaces being but little damaged, the adhesions should be broken down under chloroform, care being taken that the force employed does not inflict damage on the bones or muscles. The ensuing inflammation must be met by rest and the application of an ice-bag; but on the second day gentle passive motion in all directions normal to the joint must be employed, and continued twice daily until cure is effected. This treatment is painful and tedious, and the patient, who should be encouraged to use the limb as much as possible, not infrequently refuses to undergo the necessary suffering. The adhesions may have to be broken down under chloroform several times; but the operation should not be performed so long as there is any inflammatory action going on, and must never be undertaken in cases of stiffness resulting from tubercular disease, otherwise the mischief may be reawakened. The daily use of the hot-air bath, coupled with the above measures, is to be recommended in bad cases.

When there is intimate fibrous or bony ankylosis no treatment is advisable, provided the position of the limb is advantageous; but if its utility is so much impaired as to be a serious inconvenience, the diseased joint may be resected, or an artificial joint made by division of the neck of the bone. Operations of this nature are more frequently required at the hip than elsewhere, and must be performed with as little damage to the parts as possible, and with scrupulous aseptic precautions.

In the elbow, resection should always be preferred to division, as by the former operation a useful false joint may be formed.

NEURO-MIMESIS—NEURALGIA

A joint may be the seat of severe neuralgic pain, which recurs at intervals, and is without any obvious pathological cause. In some cases the patient attributes the condition to some previous injury, while in others it appears to be the direct outcome of profound anæmia.

Symptoms.—The condition is especially met with in young women, particularly those presenting the symptoms of so-called "hysteria." The pain, which is often agonising, is intermittent, and may be limited to one particular spot or radiate along the course of an individual nerve. It is very superficial in character, and may be elicited by the lightest touch, although, if the patient's attention be otherwise engaged, manipulation of the affected joint may be practically painless. In some cases there is fixity of the joint, and the position of the limb may be characteristic of organic mischief. This can, however, be usually eliminated by a little care. The fixity, like the pain, often diminishes or disappears when the patient's attention is distracted. There is no swelling, although occasionally there may be a little œdema of the subcutaneous tissue; nor is there any increased heat; indeed, the surface temperature is often depressed. If the patient be given chloroform, so that free manipulation of the joint is possible, it will be evident that the synovial membrane and articular surfaces are healthy. In some cases the position of the limb is not that assumed by it when the articulation is diseased; in others the joint is more movable than natural and comparatively useless, in consequence of deficient muscular contraction. Muscular wasting is not usually present.

Treatment.—The patient must be reassured as to the condition of the joint, and every endeavour must be made to encourage her to use it. If there is any malposition of the limb, she should be anæsthetised, and the limb put up in its normal position and fixed by some apparatus, the patient being assured that a complete cure has been effected. Cold douching, massage, Faradism, and local blistering, or, in bad cases, the application of the actual cautery, may be advantageous. Attention to the general health is of the utmost importance. The patient should keep regular hours, live as much as possible in the open air, and take plenty of food. Iron and arsenic are the best tonics.

CHAPTER VII

OPERATIONS ON JOINTS

ASPIRATION

ASPIRATION may be required for the removal of fluid on account of its quantity or failure to become absorbed. The needle, which must be thoroughly cleaned by boiling, is inserted in the most superficial situation, so that important structures are avoided; when the fluid has been withdrawn, the needle is removed and the puncture closed with antiseptic wool and collodion, and the joint supported by a firmly applied bandage. In some cases of intractable hydrarthrosis the joint cavity may, when the fluid has been withdrawn, be injected with a solution of iodine (see p. 150).

ARTHROTOMY

A joint may require opening in order to secure drainage in cases of hydrarthrosis which resist other forms of treatment, in suppurative synovitis, or for the removal of a foreign body. Arthrotomy is sometimes performed in cases of tubercle, but as a general rule when this disease necessitates operative interference some more radical measure is required. In performing arthrotomy the joint should be freely opened by an incision so placed as to avoid important structures; if it is performed on account of suppuration two incisions should be made, one on each side of the joint. The joint cavity should be thoroughly flushed and a drainage tube inserted, but if the operation is undertaken for the removal of a foreign body, the capsule must be united by chromic catgut and the superficial wound closed (see p. 185).

ARTHRECTOMY AND EXCISION

Complete excision of a joint may be required in cases of injury, chronic suppuration, or advanced tuberculous disease. Partial excision or arthrectomy is required for cases of tubercular disease.

Arthrectomy or erasion consists in freely opening the joint, carefully dissecting away the whole of the diseased synovial membrane, and gouging away the carious areas of bone. In performing the operation as little damage as possible should be inflicted on the ligaments, upon the integrity of which the future stability of the joint depends; at the same time the surgeon, in his anxiety to preserve these structures, must not allow himself to save them at the expense of leaving the smallest quantity of diseased tissue behind; otherwise the morbid process will continue.

Operation.—The use of a tourniquet should be dispensed with, since the hæmorrhage is but slight, and if one be used there is the risk of troublesome subsequent oozing. The area of operation having been thoroughly cleaned, the joint is opened by one or more incisions best calculated to fully expose the seat of disease. If sinuses are present they may sometimes be utilised, but first great care should be taken that their walls are thoroughly scraped or dissected away, and Watson Cheyne recommends the application of pure carbolic acid, the sinus being finally plugged with iodoform gauze and allowed to heal from the bottom. The ligaments must be divided as little as possible consistently with free access to the joint cavity; at the end of the operation they should be sutured. The infiltrated synovial membrane must be carefully and systematically removed by dissection, special attention being paid to the recesses of the joint; the margins of the cartilage should be pared off with a knife, and any points of disease in it or the subjacent bone must be entirely removed by gouging. During the operation the joint should be irrigated with sterilised water. When all diseased tissue has been removed and the divided ligaments sutured with chromic gut, the cavity should be filled with sponges to prevent oozing while the sutures are passed through the superficial structures. It is not advisable to suture the capsule, since so doing may imprison any fluid exudation in the joint cavity. When all the sutures have been inserted the sponges are removed, the joint surfaces are flushed, dried, and treated with iodoform emulsion; the sutures are then tied while pressure is applied by an assistant. A drainage tube is not required, but the wound should be left open for about half an inch on each side to allow serum and blood to escape. The wound is dressed with a dry antiseptic dressing and the limb kept on a suitable splint at complete rest for ten days, during which time the dressing should not be disturbed unless the patient exhibits symptoms necessitating an examination of the wound. At the end of this time the wound is dressed and the sutures removed; a collodion dressing is then applied to the scar. The subsequent treatment as regards the employment of passive motion or the necessity for mechanically fixing the joint depends upon its seat.

Complete excision is performed on much the same lines as arthrectomy, with the addition that as soon as the joint has been opened the articular ends of the bones are freed and their cartilage-covered surfaces sawn off; the synovial membrane is then thoroughly removed as in arthrectomy, and if ankylosis is aimed at the bone ends may be united with silver-wire or ivory pegs.

Comparison between complete and partial excision.—The most successful cases for arthrectomy are those in which there are no septic sinuses, and in which the disease, originating in the synovial membrane, is more or less limited in extent and has not advanced to the stage of suppuration; the presence of suppuration and sinuses does not, however, necessarily exclude arthrectomy. If the cartilages are extensively diseased and caries of the bone ends is advanced, complete excision is the proper operation. Speaking in the abstract, arthrectomy is the better operation in patients under sixteen, whereas complete excision is more applicable to adults. The shock and danger attending the two operations is about equal. Excision is more easily performed than arthrectomy, because the free removal of the articular surfaces gives the operator plenty of room and affords ready access to the synovial pouches. As regards the ultimate result, complete excision causes much greater shortening and greater weakness than does arthrectomy. The degree of mobility after excision depends on whether or not passive motion has been employed; true ankylosis does not occur in arthrectomy, but there may be almost complete fixity or slight movement, and if passive motion has been employed, such movement may be very good. Owing to the ankylosis after complete excision, the tendency to flexion and deformity of the limb, which is so troublesome to avoid after arthrectomy, does not occur.

ARTHRECTOMY AND EXCISION OF THE HIP

Excision of the hip is best performed by an anterior incision extending from a point half an inch below and external to the anterior superior iliac spine downwards for about three inches (Fig. 70, *a*). This incision opens up the space between the tensor vaginæ femoris and sartorius muscles, and, beneath these, that between the gluteus minimus and rectus. The hip may also be excised by a straight incision over the great trochanter and parallel with the axis of the shaft of the femur (Fig. 70, *b*), or by a curved incision over the trochanter. The advantages of the anterior operation are that the joint is reached without any damage to muscles or vessels, that the abscess sac is opened with the least disturbance of soft tissues, and that important ligaments about the joint, upon the integrity of which its future usefulness in great measure depends, are not wounded.

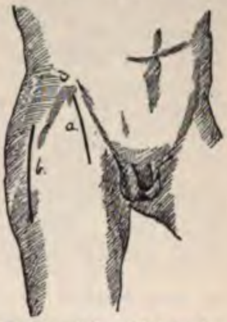

FIG. 70.—Line of incision for excision of the hip by (*a*) the anterior route, and (*b*) by the vertical route over the great trochanter.

When, by the anterior incision, the gluteus minimus and rectus have been separated and the capsule exposed, it should be opened and the interior of the joint and abscess cavity thoroughly scraped with the flushing gouge, the detritus being continually washed away with sterilised water.

If the epiphysis of the head is found loose it must be removed, or the carious upper portion must be taken away by dividing the neck of the bone with an Adams's saw. Carious or necrosed bone in the acetabulum must be removed, and if the floor has been perforated and the abscess cavity extends under the obturator fascia, the perforation must be enlarged sufficiently to allow of free scraping and flushing of the abscess, care being taken that the wall is not damaged and the pelvic cavity thereby opened. When all diseased tissue has been removed the area of the operation should be packed with sponges and silkworm-gut sutures inserted in the superficial wound. Before these are tied the sponges are removed, the cavity finally dried and thoroughly treated with iodoform emulsion; external pressure with a flat sponge is now employed so as to prevent oozing into the wound, and the sutures are tied, no drainage being employed. The wound must be dressed antiseptically and the limb placed on a Thomas's splint in a position of slight abduction so that the neck of the femur is approximated to the acetabulum. In ten days the dressing should be removed, and if the wound is found healed the limb is again placed on a Thomas's splint, which should be worn perpetually for from four to six months; at the end of which time, provided the joint is sound, the splint may be left off during the day, but should be worn at night for some weeks longer to counteract the tendency to flexion. In an ideal case primary union follows the operation and the patient recovers with a somewhat shortened limb, but with firm fibrous ankylosis which may permit of some slight movement. All cases, however, do not run the desired course, and it may be found after some three or four weeks that the scar is itself the seat of tubercle; if this be the case it should be cleanly excised; any tubercular abscess that may be present must be scraped and the wound treated as above stated and closed by sutures. Sometimes the abscess again refills and the operation must then be repeated.

ARTHRECTOMY AND EXCISION OF THE KNEE

The knee joint may be exposed by a lateral, transverse, H-shaped or horseshoe-shaped incision (Fig. 71), the last being preferable in most cases. This is made from the most prominent part of one condyle to a corresponding point on the opposite side and extends downwards to the tubercle of the tibia, the ligamentum patellæ being divided; in some cases the patella may be sawn across.

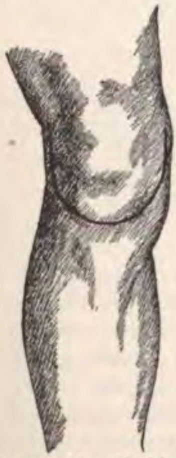

FIG. 71.—Line of incision usually employed for arthrectomy or excision of the knee joint.

Arthrectomy.—When the joint has been thoroughly exposed the whole of the diseased synovial membrane must be systematically dissected away, the ligaments being divided sufficiently to permit of this being thoroughly done. During the operation the parts should be continually flushed with hot water, and when all the disease has been removed and the divided ligaments sutured, the joint should be packed with sponges while the sutures are being introduced. The joint is finally flushed, dried, and treated with iodoform emulsion, and the wound sutured without drainage; an aseptic dressing is applied and left untouched for ten days, the limb being supported on a back splint with a foot-piece. The sutures should then be removed, and the limb put up in a plaster casing, which should be kept on for two months or, if there is any tendency to flexion, for a longer period. This tendency is very marked in children, and unless the uniting medium be dense and strong, gradually causes it to yield and thereby enfeebles the stability of the joint. Some yielding at the epiphysary line may occur, so that prolonged fixation is necessary. When it is considered permissible to discontinue the use of plaster, the patient should be provided with a good knee-cap.

Excision.—Excision of the knee may be performed through any of the incisions already given. When the joint has been freely opened and the ligaments divided, the lower end of the femur is pushed out of the wound and the diseased part sawn off. No greater thickness of bone than is absolutely necessary should be removed, and in young people every care must be taken to preserve the epiphysary line intact. In sawing the femur a broad excision saw should be used and held at right angles to the shaft of the bone and parallel with the plane of the articular surface; the section may be safely made from before backwards. The upper end of the tibia is now cleared, and a slice not exceeding three-quarters of an inch in thickness is sawn off. If the patella is diseased, it should be removed, or it may merely require gouging.

When the bony surfaces have been cut away free access to all parts of the synovial cavity is obtained, and all the pulpy and diseased synovial membrane must be carefully removed by dissection and by the use of scissors and forceps; posteriorly, care must be taken not to damage the popliteal vessels. The sawn surfaces should be in accurate apposition and united by means of ivory pegs or silver-wire.

The bleeding is carefully arrested, the divided ligaments are sutured, and the wound dried, treated with iodoform emulsion and closed, a small drain being provided at the outer side. The limb is dressed and kept on a back splint provided with a foot-piece and reaching from the fold of the buttock. If all goes well the dressings should be left undisturbed for ten days or a fortnight when the stitches should be removed. The joint must be kept fixed on a splint until bony ankylosis is firm, and subsequently a stout knee-cap must be worn for a year or longer.

As regards the choice between arthrectomy or excision in any given case, it may be generally stated that arthrectomy is the better operation before the age of fifteen, since it does not interfere with the epiphysary growth; after that age growth has proceeded so far that excision gives good results. In adults after the age of thirty-five, excision of the knee is not a successful operation, amputation being usually the wiser treatment if the disease is extensive.

EXCISION OF THE ANKLE JOINT

The ankle joint may be excised through an anterior incision between the two malleoli; this has, however, the disadvantage of dividing the anterior tibial artery and nerve and the extensor tendons which must be sutured before the wound is closed. Another method is by an anterior incision on each side in front of the malleolus, beginning one or two inches above the joint, and extending a sufficient distance along the dorsum of the foot to give plenty of room. The malleoli are then divided, except in the case of young patients in whom such a procedure might be followed by arrest of growth at the epiphysary line; the divided malleoli should, at the conclusion of the operation, be wired. The astragalus is now removed, and thus free access to the joint is obtained, the removal of this bone very slightly impairing the utility of the foot.

A third method of excision is by an incision along the posterior border of the fibula at its lower part, carried forwards from the tip of the malleolus to within a short distance of the base of the fifth metatarsal bone, the peroneal tendons are hooked aside, the lower end of the fibula is divided, and the malleolus removed. A similar incision is next made on the opposite side along the inner edge of the tibia, the tendons behind the inner ankle are hooked aside, the internal lateral ligament is divided, and the lower end of the tibia and the astragalus are removed; the synovial membrane is dissected away and the joint cleansed and treated with iodoform emulsion. The superficial wounds are closed, but on the outer side a small space is left open to allow of the escape of serum.

Excision of the ankle joint is not a very satisfactory operation, and in many cases amputation by Syme's method is preferable.

After excision of the ankle joint the limb should be placed on a back splint with a foot-piece, and the foot should be very slightly extended, so that, when fibrous ankylosis results, the toes may point somewhat towards the ground.

EXCISION OF THE SHOULDER JOINT

This joint is usually exposed by a straight incision carried downwards for about three inches from a point just external to the coracoid process, the arm being rotated outwards so that the bicipital groove looks forwards and is laid bare by the incision after division of the deltoid muscle (Fig. 72). If the tendon of the biceps is intact it is hooked outwards, and the arm being rotated outwards as far as possible the tendon of the subscapularis and the exposed part of the capsule are divided; the tendon is now hooked inwards and the arm rotated inwards, the rest of the capsule and the muscles attached to the great tuberosity are then divided.

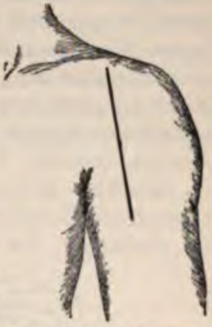
FIG. 72.—Line of incision usually employed for excision of the shoulder joint.

The operation may now be completed without any further displacement of the bone; but if complete excision is aimed at, the head of the bone is displaced by the assistant in charge of the arm, the posterior part of the capsule is divided, and the area of the diseased bone removed by the saw. The glenoid cavity is now examined and any disease removed by gouging; the operation being completed the wound is closed without drainage. When the wound has been dressed, a small pad is placed in the axilla and the arm is bandaged to the chest. Union is usually rapid, and the sutures may be removed on the tenth day, after which gentle passive motion in all directions should be employed with a view to forming a false joint. Excision may also be performed through a posterior incision, or by raising a deltoid flap, but these methods should be avoided if possible. Excision of the shoulder joint may be required for gun-shot injury or disease, and the head of the humerus is sometimes removed in cases of unreduced dislocation or new growth. Fibrous ankylosis with some degree of movement or false joint results.

EXCISION OF THE ELBOW JOINT

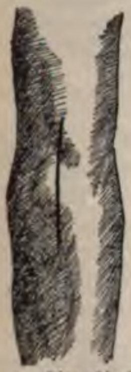
FIG. 73.—Line of incision usually employed for excision of the elbow joint.

This operation is usually performed through a longitudinal-median incision, the centre of which crosses the tip of the olecranon process (Fig. 73), but it may also be performed by two longitudinal-lateral incisions, or by an H-shaped or horseshoe-shaped incision; in the two last the olecranon may be sawn through, turned upwards, and subsequently sutured. In excision by the median-longitudinal incision the surgeon first reflects the structures from the inner side, putting them on the stretch with his thumb and carefully peeling off everything down to the bone; in doing this care must be taken not to damage the ulnar nerve which lies behind the internal condyle. The soft structures on the outer side are similarly reflected and the bones disarticulated. In arthrectomy the synovial membrane is now dissected away and carious pits in the bones gouged out; but if the excision is to be complete, the lower end of the humerus is extruded and sawn off and the upper ends of the forearm bones are similarly treated. When this has been done the synovial membrane is dissected away. The wound is thoroughly cleansed, dried, treated with iodoform emulsion and sutured, a small gap being left for drainage. An antiseptic dressing is applied, and the limb, with the forearm semi-pronated and semi-flexed, is placed at rest upon a pillow. In ten days the sutures may be removed and passive motion commenced, the movements being those of flexion, extension, pronation, and supination. In all cases of arthrectomy or excision of the elbow, great care must be taken that the ulnar nerve is not damaged; but should this unfortunately occur, the ends must be immediately sutured; it is also necessary that the anconeus fascia and the attachment of the brachialis anticus muscle be not wounded, otherwise voluntary movements of flexion and extension will be materially impaired.

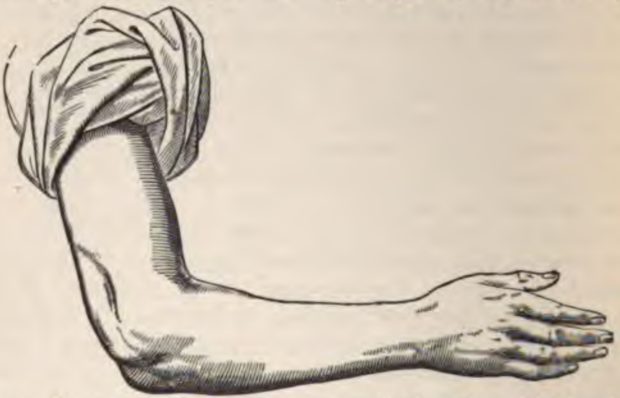

FIG. 74.—The same arm as Fig. 61, p. 170, some months after excision of the elbow joint (Fergusson).

EXCISION OF THE WRIST

Excision of the wrist is but rarely required, for if the disease of the articulation is so great that a partial operation offers no hope of cure, amputation is usually necessary, the more so if the morbid process has extended to the adjacent tendon sheaths. Complete excision is performed by Lister's operation, for an account of which the reader is referred to a work on Operative Surgery. When tubercular disease of the wrist is limited and not far advanced, cure may sometimes be effected by a partial arthrectomy, the incision being so planned as to avoid important structures round the joint, while at the same time giving access to the area of disease by the most direct route.

CHAPTER VIII

DISEASES OF NERVES, MUSCLES, TENDON SHEATHS, AND BURSÆ

DISEASES OF THE NERVES

NEURITIS OCCURRING INDEPENDENTLY OF INJURY[1]

NEURITIS may occur independently of injury, and affect one or many cords (*multiple neuritis*). When it affects the terminations of the nerves, it is said to be *peripheral.*

Causes.—Neuritis may be due to cold, or to the admixture of certain poisons with the blood; of these, lead, causing musculo-spiral paralysis, is a notable example. The poisons of some micro-organisms (*e.g.* B. diphtheriæ) seem to have a special effect upon the peripheral nerves. Syphilis and chronic alcoholism also occasion an affection of the peripheral nerves, which Bowlby considers is rather of the nature of degeneration than true neuritis. In some cases neuritis may occur without any appreciable cause.

Effects.—The changes which are induced by these various conditions are very variable, not only as regards their onset and symptoms, but also in respect of the ultimate prognosis.

Neuritis from cold or peripheral neuritis from unknown causes, may be very sudden in its onset, and produce complete temporary paralysis, and perhaps loss of sensation, which, however, soon passes off under Faradism. Paralysis due to cold is not uncommonly seen in the case of the facial nerve (*Bell's palsy*); but whether or not this is due to a genuine neuritis is by no means certain. It is sometimes induced by the patient sitting against the open window of a railway carriage with the cold wind on his face. A similar condition is sometimes met with affecting the nerves of the brachial plexus, although no cause may be forthcoming.

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[1] For a full account of these conditions the reader is referred to a work on Diseases of the Nervous System.

Peripheral neuritis is associated with some cases of diabetic gangrene, and seems to be the direct cause of the mortification (see p. 84, vol. i.). It is also present in perforating ulcer, and in some cases, at least, seems to be the causative factor in Raynaud's disease (see p. 82, vol. i.).

Peripheral neuritis is also responsible for some of the trophic lesions associated with leprosy.

PERFORATING ULCER

Perforating ulcer is usually met with in connection with tabes dorsalis, but may also arise in association with peripheral neuritis or other pathological condition of the nerves. An ulcer of similar character, if not identical, is sometimes met with as the starting-point of diabetic gangrene, and the gangrene which ensues in Raynaud's disease and spreading obliterative arteritis, is a closely allied condition.

Signs.—The disease is often symmetrical, and usually begins as a hard corn on the ball of the great toe. The epithelium separates, the underlying tissues break down, and a sinus results, which gradually extends in depth and area; its extent is only recognised by probing. The progress of the case is painless, except when the patient walks. Sometimes the surrounding parts are more or less anæsthetic. As the destructive process extends, the metacarpo-phalangeal joint may be opened and the bones become carious. In bad cases the destruction is considerable, and the sinus may open on to the dorsum of the foot. As the disease progresses the destruction may lead to loss of considerable portions of the foot, and in cases of ulceration far back large portions of the tarsus may be destroyed resulting in foreshortening of the foot (*pied tabetique*). Sometimes moist gangrene supervenes.

Treatment.—Rest should be enjoined, and the ulcer must be kept perfectly clean and treated on ordinary aseptic principles. In the early stages cure may sometimes be effected by these means, and, provided the patient's health remains good, and especially if he abstains from alcoholic excess, the cure may be permanent. In more advanced cases the sharp-spoon, or even amputation, may be necessary, but should not be performed unless the disease of the cord is moderate in amount. Amputation should be performed above the anæsthetic area.

NEURALGIA

Causes.—Neuralgia is frequently dependent upon some peripheral irritation, such as the presence of carious teeth; in other cases the pressure of a growth, adhesions, a bulbous nerve-end, or the implication of the nerve in a scar may excite it. Neuralgia may also be occasioned by neuritis or cold. It is more common in women than men, and in the branches of the fifth cranial than in any other nerve. No doubt, in some cases, *e.g.* in hysterical women, the pain is due to central changes and to an increased excitability of the nerve fibres. Severe neuralgia is not uncommon as a result of chlorosis.

Symptoms.—The attacks are often distinctly periodic and may come on from exposure to cold, digestive disturbance, or some quite trivial cause. The pain is excruciating, cutting or burning in character, and radiates along the branches of the nerve. It is excited by pressure along the nerve trunk, and at certain places definite "tender spots" are present; these often correspond with the exit of a nerve from a bony foramen, or with the point at which it becomes superficial.

In chronic cases of neuralgia the hair may fall, or become coarse, thickened, and grey; trophic changes and vesicular rashes may be met with on the skin.

Treatment.—All sources of irritation must be removed; and if the nerve is compressed by a scar, this should be excised. In neuralgia of amputation stumps the bulbous ends should be excised together with an inch or two of the nerve (p. 213, vol. ii.). If the patient is chlorotic, iron, good food, quinine, and tonics, with change of air, will prove beneficial, and may ultimately cure. Numerous antispasmodics, tonics, and local sedatives have been employed in the treatment of neuralgia, and may be given a trial in obstinate cases. Counter-irritants, galvanism, shampooing, and friction are also beneficial.

If, in spite of all treatment, the neuralgia persists, nerve-stretching, neurotomy, or neurectomy should be tried in the order mentioned.

EPILEPTIFORM NEURALGIA—TIC DOULOUREUX

Epileptiform neuralgia may occur at any age, but is most usual after forty, and nearly always affects the branches of the fifth cranial nerve. It may be traced to peripheral irritation, but in some cases no cause can be assigned, and if one branch of the nerve has been excised, the neuralgia may, after a time, attack others.

The attacks commence with great suddenness, and often without warning. The patient is seized with the most agonising pain, so that he may writhe upon the floor or attempt self-destruction. The pain is sometimes hot and burning, at others it is stabbing, or feels as if the flesh were being torn with red-hot pincers. The intensity of the pain is crushing and is the most severe ever experienced. The attack lasts a few seconds, and is succeeded by others, without, perhaps, any appreciable intervals. Such attacks may recur day after day and then disappear, perhaps not to recur for weeks or months. Like the spasms of tetanus, an attack of epileptiform neuralgia may be determined by the most trivial causes, such as a draught, movement of the facial muscles, an attempt to swallow, and the like.

Treatment.—The ordinary treatment for neuralgia may first be given a fair trial, but must not be too long persevered with, since the patient's general health is often undermined by the severe agony during the attacks, and the haunting dread of their recurrence. If ordinary means fail, nerve-stretching must be performed; and failing to relieve the patient by this means, neurotomy or neurectomy becomes necessary. The recurrence of pain in other branches of the fifth may necessitate further operative interference, and as a last resource the Gasserian ganglion may be removed. In these unfortunate cases the patient will readily submit to anything offering him a chance of relief, and few surgeons would hesitate to perform any operation, however formidable, with this end in view.

SCIATICA

Sciatica usually occurs in patients beyond middle life, and is often associated with rheumatic tendencies. Most frequently no local cause can be assigned, but such should always be sought for, and the possibility of reflex irritation must not be overlooked. Among local causes of irritation the pressure of a tumour in the course of the nerve or within the pelvis, pelvic or hip-joint abscess, and sacro-iliac disease, may be specially mentioned. The pain radiates along the course of the nerve and may be distinctly periodic, although some dull aching may be more or less continuous. A tender spot may be present where the nerve escapes from the sciatic notch, or from beneath the gluteus maximus. Muscular wasting or rigidity, and consequent lameness, may result. The treatment is that for neuralgia. Flying blisters, galvanism, and ultimately nerve-stretching being the methods usually relied on.

NERVE-STRETCHING

Nerve-stretching has been recommended and practised for a variety of conditions, differing very widely in their causation and symptoms; thus it has been applied as a therapeutic agent in many diseases of the brain and cord, in locomotor ataxy, epilepsy, paralysis agitans, myelitis, tetanus, and other conditions, but the results are not such as foster much hope from the operation in such cases, and in most of these conditions, at any rate, it has been abandoned.

Nerve-stretching is undoubtedly valuable in intractable cases of neuralgia, in chronic neuritis in which the nerve is bound down by adhesions, in traumatic epilepsy following on injury to a nerve, in facial and local spasm (*e.g.* clonic torticollis), and in lepra anæsthetica.

The operation and its effects.—When the nerve has been isolated and freed from any adhesions which may be present, it may be stretched by means of a hook or by the fingers. It should be stretched by continuous and equable traction from the periphery and from the proximal end. As the nerve is stretched, it may be felt to yield and a crackling sensation is often experienced. The amount of force to be used necessarily varies with the size of the nerve. It may be generally stated that any nerve can be stretched about one-twentieth of its length before rupture will occur; the extensibility of the nerves of the upper limbs seems to be somewhat greater than those of the lower, and in all cases the extensibility is greatest near the cord and gradually slightly diminishes towards the periphery.

The anatomical effects of stretching.—When a nerve is stretched, the trunk is loosened from the sheath (which may be torn) and is separated from any adhesions which it may have contracted. Some of the vessels of the sheath are torn, and hence there is slight ecchymosis. Some of the nerve fibres are undoubtedly ruptured, and subsequently undergo degeneration and repair as they would do if the nerve had been divided, but degeneration is less rapid and occurs to a more limited extent.

The physiological effects of stretching.—These necessarily vary with the amount of damage which has been inflicted, and hence with the degree of stretching. The motor and sensory functions are diminished, and if the stretching has been considerable, may be abolished; the sensory effects are more marked than the motor. Trophic changes practically never occur unless the stretching has been very violent.

The beneficial effects of nerve-stretching may be due (1) to freeing the nerve from adhesions; (2) to rupture and loosening of the sheath; (3) to freeing of the nervi-nervorum from adhesions; and (4) to restoration of the proper control of the nerve centres over the fibres when they repair after the primary degeneration which has occurred (Callender). No doubt good may be caused by any one of these means, and in some cases by a combination of them.

NEUROTOMY AND NEURECTOMY

Mere division of a nerve or excision of part or the whole of its length is only practised in the case of severe and intractable neuralgia after nerve-stretching has failed. Partial neurectomy is sometimes performed for the removal of a neuroma; in such cases the ends are sutured after the nerve has been stretched, or a graft is interposed between the cut ends. Neurotomy and neurectomy are especially employed on the branches of the fifth cranial nerve for the cure of epileptiform neuralgia.

OPERATIONS ON SPECIAL NERVES

A nerve may be exposed in any part of its course by making an incision in its line and conducting the operation on the same principles which guide the surgeon in the exposure of an artery. If nerve-stretching is undertaken in consequence of some condition which is probably of traumatic origin, the nerve should be exposed at the supposed seat of damage; but in cases in which the operation is undertaken for causes arising independently of injury the various nerves are exposed at the "seat of election."

The supra-orbital nerve (Fig. 75, *a*, p. 206) may be exposed by a small transverse incision where it leaves the orbit by the supra-orbital notch, which can be easily felt at the junction of the inner and middle thirds of the upper margin of the orbit; the scar will be hidden by the eyebrow.

The infra-orbital nerve (Fig. 75, *b*, p. 206) is marked by a line from the supra-orbital notch to the interval between the bicuspid teeth, and is best exposed by an incision just below the orbit. It lies beneath the levator labii superioris, which must be hooked aside.

Meckel's ganglion (Fig. 75, *c*, p. 206).—The infra-orbital nerve is exposed by a curved incision beneath the orbit, the convexity being downwards; the anterior wall of the antrum is trephined, and the infra-orbital nerve traced backwards by chipping away the floor of the canal, the position of which may be indicated by a probe passed along it. The posterior wall of the antrum is now opened, and the nerve being traced further back, the ganglion is reached and removed with a fine pair of curved scissors.

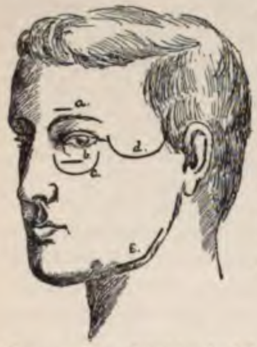

FIG. 75.—Line of incision for (*a*) exposure of the supra-orbital nerve, (*b*) of the infra-orbital, (*c*) removal of Meckel's ganglion, (*d*) removal of the Gasserian ganglion, (*e*) exposure of the inferior-dental nerve by trephining the jaw.

The inferior dental nerve may be exposed (1) by an incision along the hinder border of the ramus of the jaw; (2) by reflecting the masseter and trephining the jaw midway between the angle and the last molar tooth (Fig. 75, *e*); or (3) in edentulous subjects by opening the canal by chiselling away the alveolar border.

The lingual nerve.—See p. 356.

The Gasserian ganglion (Fig. 75, *d*) may be reached by a curved incision over the zygoma, which is then sawn through and turned down with the masseter; the coronoid process and temporal muscle are turned upwards, the external pterygoid is then detached from the sphenoid bone and the foramen ovale is exposed. This is then enlarged by the trephine and bone-forceps, and the ganglion is removed with a curved hook.

The facial nerve may be exposed by a curved incision a little below the mastoid process. The sterno-mastoid and parotid are drawn respectively backwards and forwards, and the upper border of the digastric muscle is exposed, above which the nerve is found as it leaves the stylo-mastoid foramen.

The spinal accessory is exposed by an incision just behind the sterno-mastoid muscle, midway between the mastoid process and the clavicle. It can also be stretched in front of the muscle.

Nerves of the upper limb.—The **brachial plexus** may be reached in the neck or the axilla by incisions similar to those used for ligature of the subclavian or third part of the axillary. Any nerve of the upper limb may be exposed by an incision in any part of its course, which practically corresponds to that of the arteries.

Nerves of the lower limb.—The **great sciatic** may be exposed by an incision commencing rather above the lower edge of the gluteus maximus, in a line midway between the tuber ischii and great trochanter. The biceps muscle is drawn inwards and the nerve will be found deeper. This nerve may be stretched without operation by placing the patient under an anæsthetic and then flexing the thigh on the abdomen and extending the leg; the procedure is not without danger, especially if the popliteal artery be diseased.

The **internal popliteal** nerve may be exposed by an incision in the centre of the space, and the **external** nerve by one along the inner edge of the biceps tendon. The **tibial nerves** are exposed by the same incisions as are used for ligature of the arteries which they accompany.

NEUROMATA

Tumours growing in connection with nerves are termed neuromata. True neuromata contain nerve fibres, all others are false.

True neuromata are rare if we except the bulbous ends of damaged nerves. They consist of a fibrous (sometimes sarcomatous) basis, with small irregularly arranged nerve fibres of the medullated variety; non-medullated fibres and ganglion cells are occasionally though very rarely met with. The nerve fibres of the growth are not connected with those of the nerve trunk in which the tumour grows.

The condition known as **plexiform neuroma** is very rare; it is probably congenital and affects the nerves of the head and neck, especially those of the temple and forehead. The nerve fibres are varicose, and the main bulk of the growth is composed of fibrous and fatty or myxomatous tissue. A plexiform neuroma forms a nodulated, worm-like mass, the long axis of which is parallel to that of the affected nerves. It is often dense and hard, grows slowly and painlessly, and may resemble a fibrous overgrowth.

False neuromata are usually composed of fibrous tissue; myxoma and sarcoma is sometimes seen, and a peculiar form of the latter (glioma) is met with in the retina and optic nerve. Cysts have been recorded.

Neuromata are usually single, and rarely exceed the size of a filbert. Sometimes false neuromata are multiple, and hundreds have been met with. The nerves of the extremities are chiefly affected, but no cord is exempt.

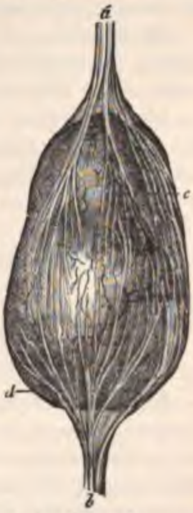

FIG. 76.—A central neuroma. At *a* and *b* the nerve fibres are united after having been separated and spread (*c*) over the tumour (*d*). (Follin).

Neuromata grow from the nerve sheath or from the connective tissue between the nerve bundles; they rarely invade the fibres, but push them aside (Fig. 76, p. 207) or grow round them.

Signs.—The tumour is oval or rounded in shape and smooth on the surface; it may be moved in a plane at right angles to the long axis of the nerve cord, but not parallel with it. The density varies with the anatomical structure of the growth. The leading symptom is pain, which may be continuous and dull aching in character, but is often paroxysmal and neuralgic. The pain may be excited by handling the tumour, and is referred to the peripheral distribution of the nerve; it may be diminished or arrested by compression of the nerve on the proximal side of the growth. In addition to the pain there may be a sense of numbness or tingling, with perverted sensation. Sometimes pain is quite absent. If motor ends are implicated there may be twitching and painful cramps of the supplied muscles. In those rare cases in which the nerve has been destroyed by the pressure of the growth, anæsthesia and motor paralysis will occur, but trophic changes are very rare.

Treatment.—A neuroma should be carefully removed by dissection, if possible without injury to the nerve trunk. If it is found necessary to remove the portion of nerve in connection with which the tumour grows, the trunk must be thoroughly stretched before this is done, so that the cut ends may be immediately sutured without tension; failing this, nerve grafting must be employed (p. 135, vol. ii.). Multiple neuromata cannot be removed if widespread. The removal of a plexiform neuroma is difficult, but may be undertaken if it is growing and causing trouble.

DISEASES OF THE MUSCLES

MYALGIA

Pain in the muscles may result from violent exercise or involuntary spasm, as after epilepsy or labour. It may also be due to strain, to bruising, or to actual rupture. Myalgia is sometimes very distressing at the onset of secondary syphilis; it is also a prominent symptom of some forms of rheumatism and gonorrhœal rheumatism.

The treatment must be dictated by the cause.

MUSCULAR ATROPHY AND DEGENERATION

Atrophy and degeneration of muscular tissue may result from disuse, as is seen in cases of long confinement of a limb on account of joint disease or any other cause. Prolonged fever, wasting disease, old age, or general paralysis also induce muscular wasting. The above causes are, however, of comparative insignificance as compared with the atrophy caused by injury of the motor nerve, the effects of which are discussed on p. 131, vol. ii.

The atrophy met with in infantile paralysis, pseudo-hypertrophic muscular paralysis, and progressive muscular atrophy need only be mentioned in a surgical work.

When atrophy is unaccompanied by degenerative changes the individual fibres retain their normal appearance but are smaller than natural; they may also be deficient in number.

Atrophy is usually associated with fatty, and, occasionally, with waxy or vitreous degeneration. In the fatty change the muscular fibres lose their cross-striation, become granular, and the protoplasm is ultimately converted into fat, which also accumulates in the interstitial connective tissue (*fatty infiltration*).

Waxy or vitreous degeneration is met with in cases of atrophy resulting from some forms of paralysis and from the acute fevers, especially typhoid. The muscular fibres are transformed into a glistening waxy material. The change may be limited to a few fibres only.

Treatment.—The treatment of muscular atrophy consists in the removal of its cause and the encouragement of nutrition by cold douching, friction, massage, moderate use and the employment of electricity.

MYOSITIS

Causes.—Inflammation of muscle may occur from a great variety of causes, and hence may assume very different aspects. It may be due to injury or to long-continued irritation, to the spread of inflammation from the cellular planes, to gonorrhœa, syphilis, septic infection, or some acute infective disease.

Symptoms.—Acute myositis is indicated by swelling and tenderness, and by acute pain if the muscle is thrown into action. In most cases the inflammation subsides under treatment by rest and warmth, but if the condition is the outcome of an infective process suppuration will probably result. Psoas abscess occasionally results from inflammation excited by injury. Chronic myositis, such as may occur from gonorrhœa or rheumatism, gives rise to the growth of scar tissue which lies between and to some extent replaces the muscular fibres, and hence the muscle becomes dense, hard, and somewhat contracted. This should be prevented by cold affusion, massage, and kneading of the muscles.

As the result of repeated irritation, and apparently owing to chronic inflammation, it sometimes happens that calcareous material forms in a muscle; this is specially seen in the adductor muscles of horsemen (*Rider's bone*).

Syphilitic myositis may occur during the secondary stage of the disease, and be widespread, so that the patient complains of general aching pains, which are accentuated by movement.

Tertiary syphilis may cause diffuse inflammatory induration, or the disease may manifest itself by the formation of gummata in the connective tissue between the muscular fibres. A gumma forms a definite tumour, which is quite painless and is unaccompanied by any signs of inflammation; it may become absorbed under anti-syphilitic remedies, or may break down and form a characteristic ulcer. Its situation within the muscle is shown by its moving with it during its contraction.

INTERSTITIAL MYOSITIS OSSIFICANS

Etiology.—Myositis ossificans is a rare disease, usually commencing between three and five years of age, and rarely after the fifteenth year, although cases in later life have been recorded.

About four-fifths of the cases occur in males. The disease is closely allied to muscular rheumatism and rheumatoid arthritis, and although it is not hereditary, there is some underlying constitutional predisposition. In many cases it is distinctly traceable to some trivial injury.

Morbid anatomy.—The inflammation affects the interstitial connective tissue, the muscular fibres merely undergoing consecutive atrophy and degeneration. The inflammatory exudate instead of being absorbed becomes converted into true bone, which is, however, softer than normal bone, since it contains nearly 10 per cent less inorganic matter. The bony material is usually in the form of broad flattened plates, and may completely replace the normal muscle which it more or less resembles in shape; occasionally the masses are nodular or irregular and stalactite-like. True osteomata are sometimes associated, and ossification of the ligaments, especially those of the vertebræ, is often met with. The joints are unaffected, although their movements may be abolished owing to the ossified muscles passing over them acting as rigid bars or splints. Hallux valgus and microdactily are sometimes present, and this too frequently to be a mere coincidence, although what connection they have with the disease cannot be suggested; a similar condition of the thumb has been recorded. The viscera are unaffected.

Signs and symptoms.—The disease may begin insidiously or may be directly traceable to injury; a slight blow on a muscle occasions swelling, redness, heat, and tenderness, which subside in a few days, leaving a dense, indurated, but usually painless mass. Steady progression of the mischief may ensue, or there may be long periods of remission, fresh attacks being occasioned by injury or unknown causes.

As the ossification proceeds movements become increasingly difficult, and in advanced cases the patient, rigid as a statue, is rendered quite helpless. The general health remains good, but at each attack there may be some slight fever with malaise. When the thoracic muscles are converted into bone respiration necessarily becomes hampered, and these patients not infrequently die of pneumonia or bronchitis.

Sloughing of the tissues over the bony nodules may occasion considerable pain and suppuration.

The muscles earliest affected are the trapezii, latissimi dorsi and rhomboids, succeeded by the deeper muscles of the neck and back, those of the thorax, and ultimately by the muscles of the limbs. It is noticeable that the diaphragm and abdominal muscles, which are essential to respiration, usually escape, or are only very slightly affected.

Prognosis.—The disease may last for many years, either steadily and slowly progressing, or with distinct intermissions. Even when the patient is quite helpless he may live for years. Death ultimately results from some pulmonary complication, or from exhaustion or septic poisoning in consequence of sloughing over the bony masses.

Treatment.—No curative measures are known. The treatment consists in the avoidance of injury and cold, and the prevention of bed-sores. Iodides, arsenic, quinine, counter-irritants, excision of the bony nodules, and many other remedies have been tried, but all are apparently useless.

TUMOURS OF MUSCLE

Primary tumours of muscle are uncommon, but secondary invasion by sarcoma and cancer is frequently seen.

Lipoma, **nævo-lipoma**, **fibroma**, **enchondroma**, and **sarcoma** are the primary tumours, and they spring from the interstitial tissue.

The situation of the growth is determined by observing its movements to correspond with the contraction of a definite muscle.

Fig. 3, p. 6, is from a case of cavernous angioma of the gracilis muscle.

The treatment consists in removal of the growth without unnecessary damage to the muscular tissue which is pushed aside by and stretched over the tumour. Sarcoma necessitates the removal of part or, if possible, the whole of the affected muscle or amputation of the limb.

PARASITES IN MUSCLE

Tænia echinococcus.—A hydatid cyst is occasionally met with in muscular tissue, and forms a rounded, smooth, painless tumour, which may be so tense as to appear solid. The tumour moves with the muscle and becomes harder during its contraction.

The treatment consists in removal of the cyst by dissection, or failing this, in free exposure of the interior and removal of the parasitic cyst wall, the wound being allowed to heal by granulation.

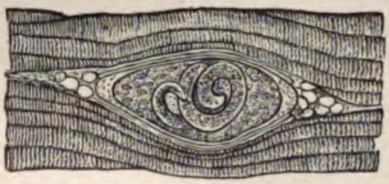

FIG. 77.—Trichina spiralis. The live trichina is contained within a capsule surrounded by connective tissue between the muscle fibres (Patrick Manson, Allbutt's *System of Medicine*).

Cysticercus cellulosæ.—The larval form of tænia solium (pork measle) is occasionally met with in man.

The cysticercus grows in the connective tissue between the muscular bundles or in the intermuscular planes; it gains entry through the stomach, the eggs being taken in underdone measly pork.

The small cysts excite chronic inflammation, leading to local patches of induration which simulate tumours. The diagnosis would only be made by exploratory incision when the cyst should be removed.

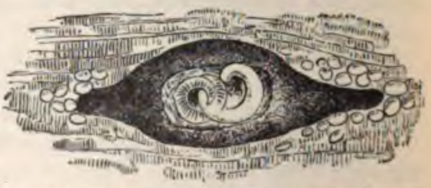

FIG. 78.—Trichina spiralis. The parasite is dead, and the capsule within which it lies has become calcified (Patrick Manson, Allbutt's *System of Medicine*).

Trichina spiralis.—The immature form of this worm passes from the intestinal canal (which the viviparous female inhabits) to the voluntary muscles, especially selecting the depressors of the hyoid bone, the diaphragm, and the intercostal muscles.

The trichinæ usually become enclosed in opaque white cysts, which frequently become calcified (Fig. 78). The cysts are visible as minute white specks, and the trichinæ, coiled up inside them, may be detected with a lens.

Symptoms.—Trichiniasis is characterised (1) by gastro-intestinal disturbance; (2) by severe muscular pains and febrile disturbance during the passage of the embryos to the muscles. With the invasion of the parasites the affected muscles may swell and become very tender, and during this stage, which may last six weeks, the patient usually dies, but should he survive it recovery will ensue, for the encapsuled trichinæ die and the cysts become calcareous.

The treatment consists in the main of smart purgation, which should be repeated at intervals in order to free the intestinal canal of the adult worms. During the migration of the embryos the strength must be maintained by plenty of food and stimulants.

Diseases of Tendon Sheaths

NON-SUPPURATIVE TENO-SYNOVITIS

Causes.—Simple inflammation of a tendon sheath or of the lymph spaces of a tendon may be due to repeated strain, or to some constitutional condition, such as gout or rheumatism. The tendon sheaths on the back of the wrist are commonly affected, and the lymph spaces of the tendo Achillis may inflame, especially after long walking in heavy and new boots.

Symptoms.—There is some pain which is increased by movement of the tendon, and there may be slight fulness from effusion into the sheath, coupled with increased heat and local tenderness. Tendon crepitus is readily felt, and is diagnostic. It conveys a sensation similar to that caused by doubling a leather strap in the hand; it is due to the movement of the tendon in the sheath, which is lined with lymph, and is analogous to pleural friction.

Treatment.—Complete rest, with gentle friction over the tendon, will soon allay the inflammation. If the pain persists, blistering will be beneficial. Recurrent attacks are not uncommon, and must be prevented by confining the movements of the tendon by an elastic or eather support, and by treating any general cause (*e.g.* gout) to which the inflammation may be traceable.

ACUTE SUPPURATIVE TENO-SYNOVITIS

Occasionally suppuration occurs in tendon sheaths, either as the result of infection through a small wound as in cases of thecal whitlow, as a consequence of general infection of the system, or as a secondary effect of neighbouring joint disease. The suppuration is evidenced clinically by signs and symptoms common to suppuration generally, but the process tends to spread along the tendon sheath.

Whitlow.[1]—Whitlow is an acute spreading inflammation of the fingers or toes, due to the invasion of the tissues by pyogenic organisms, and resembling in its general characters ordinary cellulitis. The fingers are far more commonly affected than are the toes, owing to the greater frequency with which they are exposed to infection. Whitlow is rarely seen in the better classes, but is common in butchers, cooks, housemaids, and other persons whose occupations render them liable to small wounds about the hand. In some cases the infective agent may gain entrance at the time of the infliction of the wound; in others the wound, which may be a mere pin prick, becomes subsequently poisoned. Whitlow is more likely to occur, and to run a rapid and severe course in persons of feeble health, and in those who are broken down by privation or alcoholic excess.

Varieties.—Whitlow is usually divided into four degrees, according to the extent of the inflammation; but the simplest form may, if neglected, pass on to the most severe.

(1) *Sub-epidermic whitlow* is merely a collection of pus beneath the epidermis, and usually occurs about the ungual phalanx. When the epidermis has been removed, a minute opening may be found extending into the deeper structures.

(2) *Subcutaneous whitlow* is commonly seen at the ungual phalanx, often at the bed of the nail.

(3) *Paronychia tendinosa* is the term applied to the condition when it attacks the tendon sheath.

(4) *Sub-periosteal whitlow* is really a suppurative periostitis, and is usually consequent on the spread of the inflammation to the deeper structures.

Signs and progress.—The simple forms of whitlow cause swelling and great pain round the point of infection. The epidermis is raised up by a collection of pus which may extend widely, or if the inflammation affects the pulp of the finger and bed of the nail, the existence of pus is indicated by the tension and throbbing pain. A prompt and free incision may arrest the process, or it may be found that the ungual phalanx has already necrosed. Loss of the nail is a common occurrence. When the tendon sheath is affected, it becomes filled with pus, and, owing to the unyielding nature of the fibrous sheath, the tension causes intense throbbing pain. Unless the pus be evacuated by timely incision, the tendon may slough. The process extends backwards towards the palm. In the case of the second, third, and fourth fingers (the tendon sheaths of which do not communicate with the common sheath at the wrist) the synovial sac yields, and the pus finds its way into the cellular tissue of the palm beneath the deep fascia, and thence spreads upwards, under the annular ligament, to the cellular planes of the forearm; the pus may

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[1] Although whitlow does not necessarily involve the tendon sheaths, it is most convenient to discuss it in this chapter.

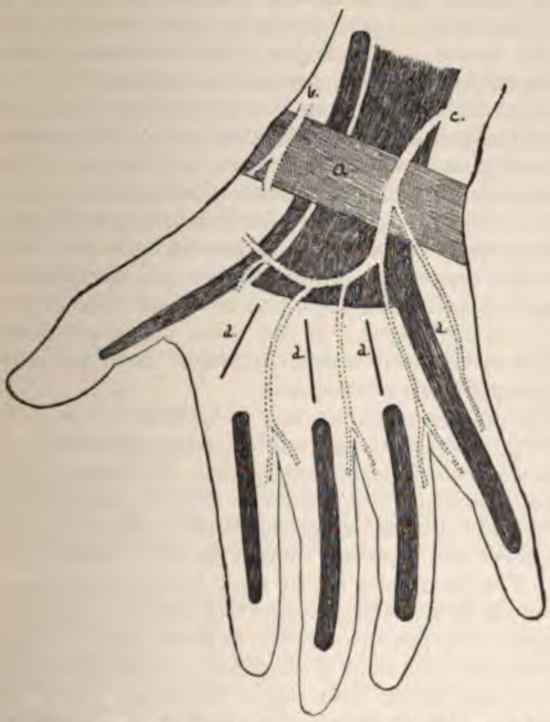

FIG. 79.—Diagram to show the extent and arrangement of the sheaths of the flexor tendons (shaded). (*a*) the annular ligament; (*b*) superficial volar artery; (*c*) ulnar artery, the palmar arch should descend a little lower than represented; (*d*) the position for palmar incisions, between the digital vessels and over the metacarpal bones.

extend backwards to the dorsum of the hand, along the course of the perforating arteries. Palmar abscess causes intense pain of a throbbing character; the fingers are flexed to relieve the tension of the palmar fascia, and there is redness with marked œdema on the back of the hand. Fluctuation cannot be made out owing to the diffuse nature of the process and the density of the palmar fascia; but if the whitlow has been incised, pressure on the palm will cause a flow of pus from the wound on the finger. Extension to the forearm is evidenced by redness, swelling, tension, and œdema.

As the synovial sheaths of the thumb and little finger communicate with the common flexor sheath at the wrist, direct extension to this will probably occur when these digits are the seat of whitlow. The involvement of the common sheath is indicated by swelling and pain; but the swelling is constricted immediately opposite the carpus, in consequence of the presence of the annular ligament. When the common sheath suppurates, it may rupture into the palm, towards the forearm, or in both directions, and the destructive process then spreads to the cellular tissue. In the worst cases the inflammation extends to the periosteum, causing necrosis of the carpal bones, and complete disorganisation of the joints.

The constitutional symptoms vary in severity with the extent of the destructive process; in the mildest forms of whitlow they are practically absent, but in severe cases, when the disease spreads to the palm and forearm, the temperature is often raised to 104° or 105° F., and there are the usual associated symptoms. Constitutional symptoms are especially severe in the enfeebled and in drunkards. The latter may be attacked by delirium tremens, and the disease is apt to run a very destructive course.

Prognosis.—The prognosis to life is good; but if the case has been neglected, and especially if the patient is very feeble and in ill-health, death may result from septic poisoning. In some cases general infection and secondary inflammation of the lungs proves fatal. The prognosis as to the future utility of the part depends upon the extent of the disease, and the promptness with which treatment has been carried out. The tendons may be bound down by adhesions, or they may slough, and in either case there is necessarily some degree of permanent stiffness, which will, however, ultimately be much improved by massage. Secondary hæmorrhage sometimes occurs when the sloughs are in process of separation.

Treatment.—The pus must be evacuated by early and free incision, and the finger must be fomented with boracic lint until repair sets in. The incision, when made in the finger, must be placed in the centre of the palmar surface, so that the vessels and nerves are not damaged. Care must be taken not to cut deeply enough to open the tendon sheath if this is unaffected.

Incisions in the palm must be so placed that the nerves and vessels are not damaged. They should be made in front of the palmar arch, in the lines of the metacarpal bones, and never transversely to the palm (Fig. 79, *d*, p. 215). Incisions in the forearm must also avoid the vessels and nerves.

When the incisions have been made, the application of pure carbolic acid to the diseased structures serves to cut short the spread of the inflammation. The limb must be enveloped in hot antiseptic fomentations, or placed in a hot arm-bath until all sloughs have separated and granulation is in progress. If a phalanx is necrosed, it should be lifted out so that the finger may, as far as possible, be preserved. In the worst cases, in which the part is totally disorganised, amputation must be resorted to; but this should never be performed while the disease is progressing, otherwise its spread to the stump is almost certain.

The constitutional treatment is that for cellulitis (see p. 125, vol. i.).

TUBERCULAR TENO-SYNOVITIS

Tuberculosis of a tendon sheath is usually met with in those of the fingers or toes, but may occur in others. The disease may be primary, or may spread to the sheath from the bone or soft structures.

The condition is precisely similar to tubercular disease of a joint or bursa, and often affects many fingers. At first the tendon sheath is filled with granulation tissue, which may become absorbed or break down and excite suppuration. In the latter case a sinus, filled with fungating granulations, opens on the surface. The finger is considerably enlarged. There is usually but little pain.

Treatment.—Before suppuration has occurred, the finger may be covered with Scott's ointment, and carefully compressed by strapping.

As soon as the granulation tissue has broken down, the diseased tissue must be removed by sharp-spooning, and the cavity allowed to heal from the bottom. In bad cases, where the bone is affected and the finger quite disorganised, amputation will be necessary.

COMPOUND GANGLION

The common sheath of the flexor tendons at the wrist, or that of the extensors of the foot, is sometimes the seat of effusion with the formation of melon-seed bodies, which may be very numerous. These cases are regarded by most surgeons as being tubercular, and in not a few the bacilli can be demonstrated in the melon-seed bodies, which are composed of fibrinous material with a fatty nucleus. The interior of the sheath is lined by a layer of granulation tissue and contains a clear, straw-coloured fluid.

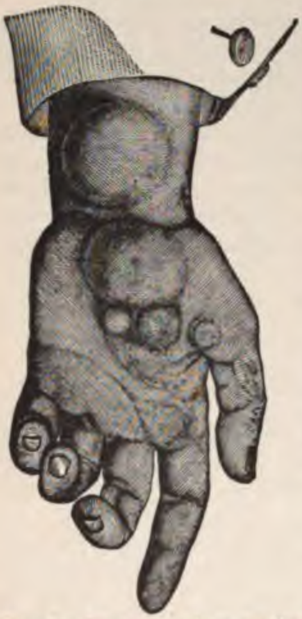

FIG. 80.—Compound palmar ganglion containing melon-seed bodies affecting the sheaths of the flexor tendons (Follin, after Acrel).

Signs. — The disease usually occurs in young people, especially delicate women. The tendon sheath undergoes gradual and painless enlargement, the swelling at the wrist being constricted at the situation of the anterior annular ligament (Fig. 80). It is tense and elastic, but distinct fluctuation may be present, and the melon-seed bodies convey a peculiar creaking sensation which is diagnostic of their presence. The condition may remain unchanged for a very long time or slow suppuration may ensue.

Disease of the wrist joint may co-exist or may follow the condition.

Treatment.—The best treatment consists in laying open the sheath from end to end (division of the annular ligament being necessary) and thoroughly removing the contents and sharp-spooning the wall. When the cavity has been swabbed out with iodoform emulsion, zinc chloride solution, or carbolic acid solution, the divided sheath is carefully closed. If this treatment fails it may be repeated, or the sac may be freely laid open and drained. Every care must be taken to prevent suppuration, for should this occur the process may spread widely and cause sloughing of the tendons or subsequent adhesions, so that the utility of the hand will be seriously impaired. By early and radical treatment involvement of the wrist may be averted, but the case should be watched for some months.

SIMPLE GANGLION

A simple ganglion is a localised bulging of the tendon sheath which contains a clear, jelly-like material like unboiled white of egg. The origin of simple ganglion is somewhat obscure, and it is probable that all do not arise in the same way. In some cases they appear to be due to a hernia of the synovial sheath through the fibrous covering, the protrusion being subsequently cut off from the general cavity of the sheath, so that the cyst has no communication with it. In others ganglion is due to the distension of one of the secreting follicles of the sheath. Ganglion is usually met with on the back of the wrist, especially in connection with the tendons of the extensor communis or extensor indicis. It chiefly occurs in young women, and is sometimes attributed to strain or previous teno-synovitis. The tumour is quite painless, oval in shape, and elastic; it moves freely with the tendon.

Treatment.—Ganglion can sometimes be "dispersed" by rupture of the sac wall by pressure or a sudden blow; this may effect a cure, but re-accumulation of the fluid is not uncommon.

If the fluid is squeezed out through a fine puncture made with a tenotome, and pressure be applied for a few days, cure usually results; but should this fail, a free incision into the sac or its removal by excision must be resorted to. Cure may also be effected by an antiseptic seton of horse-hair kept in for about ten days.

DISEASES OF BURSÆ

ACUTE BURSITIS

Acute inflammation of a bursa may result from repeated irritation by pressure, or from an open wound which has become infected.

The patellar bursa in scrubbers is not uncommonly affected (*housemaid's knee*); in those who have to sit long on hard seats, *e.g.* boatmen and coachmen, the bursa over the ischial tuberosity, and in miners that over the olecranon may inflame.

Symptoms.—There are the usual signs of acute inflammation, redness, swelling, heat, and pain, with distension of the bursa by inflammatory exudation. The removal of the cause may be followed by complete subsidence of the symptoms, or the bursa may remain chronically inflamed. Suppuration is not uncommon and will certainly follow if the inflammation is of an infective nature; it is accompanied by fever and constitutional disturbance and increased severity of the local signs. If the affected bursa communicates with a joint the inflammation may extend to its cavity.

Treatment.—Complete rest, with the application of hot fomentations, is all that is necessary in the absence of suppuration; but should pus form, it must be at once evacuated through a dependent opening and the case must be treated as one of acute abscess. The patellar bursa should be opened from the outer side; free drainage is thus obtained, and the scar is away from the point of pressure when kneeling.

SIMPLE CHRONIC BURSITIS

Chronic bursitis is due to repeated irritation and may follow an acute attack or be chronic from the first.

In one form the bursa is considerably distended with inflammatory effusion, the walls being but little thickened; in other cases the walls are enormously thickened and the cavity is reduced to a mere slit. In the former class of cases the condition is practically that of a cyst, in the latter that of a solid tumour; the diagnosis as to its origin and real nature being made by the history of the case and the situation of the swelling. Chronically enlarged bursæ frequently contain numerous free and attached melon-seed or rice-like bodies similar to those met with in tendon sheaths (Fig. 81). Such cases are often tubercular. The bursa patella is very frequently affected, and that under the deltoid is often distended with fluid which may be in considerable quantity. The bursa beneath the semi-membranosus is also often distended with fluid and may be diagnosed by its position to the inner side of and behind the joint, by its painlessness, by its elasticity and want of pulsation, and by the fact that when the knee is straightened out the cyst is rendered tense, but disappears when the joint is flexed and the fluid escapes into its cavity, with which the bursa communicates.

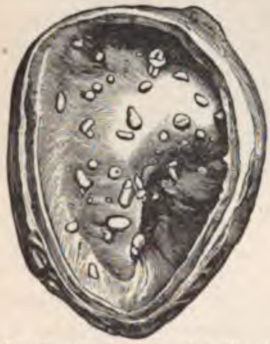

FIG. 81.—Section through a dilated prepatellar bursa, with free and fixed rice-like bodies; natural size (Ziegler).

The bursa beneath the psoas between it and the capsule of the hip joint (with which it may communicate) is sometimes enlarged and forms an elastic fluctuating tumour in the groin, lying external to the femoral vessels. The cyst may extend upwards beneath

Poupart's ligament and the iliacus muscle, or downwards into Scarpa's triangle. Bursal enlargements in association with joint disease are described on p. 182.

Treatment.—Bursæ which are chronically enlarged from thickening of the walls should be dissected out. This is rarely necessary except in the case of the bursa patellæ, the presence of which prevents the patient kneeling. The incision should be placed on the outer side of the joint and may be curved with advantage; if the incision is made over the centre of the tumour, the subsequent scar will be in the line of pressure when the patient kneels.

Simple distension of a bursa by fluid may be treated by repeated blistering, by aspiration and pressure, by aspiration and the injection of iodine, by incision, or by removal of the sac. The method to be chosen must depend in great measure on circumstances. In the case of the patellar bursa repeated blistering will often get rid of the fluid, provided the patient abstains from kneeling; or the cyst may be removed. The bursa beneath the semi-membranosus should only be removed when it is causing inconvenience; the operation is by no means easy, since pouches of the cyst extend beneath the tendons in all directions; the neck must be ligatured with chromic catgut, and the strictest aseptic precautions be observed.

BUNION—FALSE BURSÆ

A bunion is a false bursa or simple serous cyst which forms over the metatarso-phalangeal joint of the great toe as the result of undue pressure; it is commonly seen in cases of hallux valgus (Fig. 82). Similar bursæ may also occur at any part of the foot which is compressed in cases of talipes, over the prominent spines in cases of Pott's curvature, and in other situations. Bursæ may develop over parts which are constantly subjected to friction or pressure by the nature of the patient's employment; tailors frequently have a bursa lying over the external malleolus, and jockeys and steeple-chase riders constantly present a dense bursa over the front

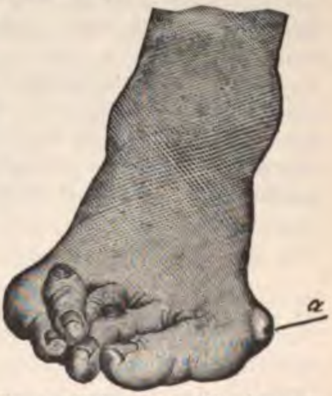

FIG. 82.—Hallux valgus with a bursa over the metacarpo-phalangeal joint. The bursa has inflamed and burst (*a*) (Follin).

of the lower end of the tibia in consequence of the pressure of the stirrup-iron. The presence of a bunion serves to minimise the ill effects of pressure, but this may lead to acute inflammation and suppuration of the sac. The treatment consists in applying a pad of spongio-piline or some other material adapted to the part in such a manner as to relieve the pressure. If suppuration occurs, the case must be treated as one of abscess. Suppuration sometimes leads to exposure of the underlying bone which may become carious or necrose.

TUBERCULAR BURSITIS

Tubercular bursitis is a rare affection and runs much the same course as does tubercular inflammation of a synovial sheath, and like it may be associated with the formation of melon-seed bodies (Fig. 81, p. 220).

Bursæ communicating with a joint may be invaded by tubercle originating within it, or may be the primary seat of the disease.

The course of tubercular bursitis is chronic and slowly progressive; when the tissue breaks down suppuration ensues and sinuses form. Tubercular bursæ should be excised.

SYPHILITIC BURSITIS

During the secondary stage of the disease syphilitic inflammation may attack the synovial sheaths and bursæ. There is considerable fluid effusion with slight pain, but the signs quickly subside under treatment.

Tertiary inflammation and gummatous nodules may also be met with; the enlargement will subside under iodides, or the gummata may break down and by involvement of the skin lead to characteristic ulceration. Syphilitic bursitis is rare and usually affects the bursa patellæ. If suppuration occurs the bursa should be removed.

CHAPTER IX

SURGICAL DISEASES OF THE BRAIN, SPINAL COLUMN, AND CORD

THE BRAIN AND ITS MEMBRANES

PACHYMENINGITIS

THE dura mater consists of two layers, either of which may be inflamed.

External pachymeningitis, *i.e.* inflammation of the outer layer, may be the result of simple injury or of some septic process, especially such as may arise in connection with suppurative otitis media. In the simple form the membrane becomes opaque, thickened, and adherent to the bone; in the septic form suppuration may occur between the membrane and the bone (*sub-cranial* or *extra-dural abscess*), or the inflammation may spread to the pia-arachnoid (*leptomeningitis*), and sub-dural abscess results.

The symptoms of pachymeningitis following an injury may not come on for some few days; indeed, the wound may be soundly healed. The patient suffers from general malaise, intense local headache, and may have a rigor. There is a puffy swelling of the scalp due to œdema (*Pott's puffy tumour*), and if pus accumulates there are all the signs of intracranial suppuration with compression. The treatment of this condition consists in early trephining and evacuation of the matter.

Pachymeningitis interna of septic origin may occur, in association with leptomeningitis, as the result of injury or syphilis. A chronic form is occasionally met with, giving rise to the formation of delicate, highly vascular, membranous layers, between which blood may accumulate owing to rupture of the vessels (*pachymeningitis hæmorrhagica* or *sub-dural hæmatoma* (Fig. 83, p. 224). According to some, these blood cysts are the cause and not the consequence of the pachymeningitis; those who hold this view contend that hæmorrhage is the primary lesion, the membranous layers being produced by organisation of the blood clot. The cyst is usually met with on the convexity near the middle line. The condition is often bilateral, and induces symptoms of compression or cerebral irritation (*Jacksonian epilepsy*) proportional to the size of the cyst or cysts. Trephining and evacuation of the contents is the appropriate treatment.

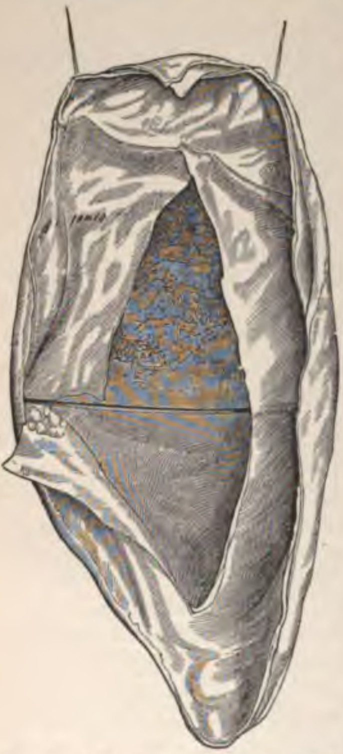

FIG. 83.—A blood cyst which has been laid open and dissected off from the parietal arachnoid in part of its extent (Holmes, *System of Surgery*).

LEPTOMENINGITIS

Inflammation of the pia-arachnoid, when not of tubercular origin, is dependent upon some infective process consequent upon injury to the skull, upon disease of the bones, otitis media, or some infective inflammation spreading from without. Such infection takes place along the lymphatic spaces of the nerve sheaths or vessels, and spreads to the base of the brain. The inflammation, which is most intense at the point of infection, becomes general. There is considerable effusion of lymph and leucocytes, and the fluid quickly assumes a puriform character. The increase of sub-arachnoid fluid causes distension of the ventricular axis and proportional compression of the cerebral cortex; the pressure in the ventricles may be increased by plugging of the Sylvian aqueduct by lymph. When the inflammation is well established it spreads to the cerebral cortex by means of the perivascular lymphatics.

Symptoms.—The disease may be ushered in by a rigor; the temperature rises; the patient feels generally ill and complains of severe headache, which gradually increases, causing him to cry out and exhibit great restlessness; pain persists even with the advent of delirium. There may or may not be vomiting. The pupils are usually equal but react slowly to light, and examination reveals the existence of optic neuritis; when coma sets in the pupils dilate. Muscular weakness and mental irritation soon give place, in view of the increasing fluid, to paralysis and deepening coma; occasionally there may be convulsions of groups of muscles when the inflammation is most intense at one particular spot, and similarly the muscular paralysis may be localised or widespread, according to the localisation or diffusion of the meningeal mischief. It will be observed that these symptoms (shortly detailed) are practically such as are produced by compression. Towards the termination of the case the breathing becomes irregular, stertorous, and stops before the heart, whose beat becomes quickened, irregular, and feeble. Death almost invariably results within the week, the fatal termination being due partly to the compression, partly to septic absorption.

Treatment.—The patient must be kept in a darkened, quiet room; the head should be shaved, and the ice-bag continuously applied. Mercury, pushed even to the extent of salivation, is highly spoken of by some. If the symptoms of compression appear to be the most prominent, trephining and drainage of the subarachnoid space may be performed; in septic cases trephining is not likely to be followed by much benefit, since the absorption of the poisonous material is the chief lethal factor.

ABSCESS OF THE BRAIN

Causes.—In the great majority of cases abscess of the brain is dependent upon chronic otitis media, and arises as a consequence of caries of the tympanic roof or mastoid antrum. In such cases the temporo-sphenoidal lobe is likely to be affected, but if the inner wall of the antrum is diseased the abscess may be met with in the cerebellum. Chronic purulent otitis media may give rise to cerebral suppuration independently of infective bone disease, and in such cases the micro-organisms gain access along the perivascular lymphatics of the internal auditory artery, which anastomoses with the vessels of the pia mater; or the abscess may be dependent on retrograde phlebitis. Abscess of the brain may also result from the same causes which excite inflammation of the membranes or thrombosis of the cerebral sinuses, and it occasionally occurs in cases of general infection and in empyema.

Morbid anatomy.—Abscess of the brain is usually situated in the white matter, its actual position in the brain being determined by its causation. If of traumatic origin, the abscess will be in more or less direct communication with the seat of the injury; if due to ear disease, the temporo-sphenoidal lobe is the usual seat, but occasionally the abscess is in the cerebellum. Abscesses are met with in the cerebrum and cerebellum in the proportion of 4 to 1. The size varies; an abscess may be very small, or may contain four or five ounces of pus; the small ones are usually in the cerebellum, those in the temporo-sphenoidal lobe being as a rule larger. The pus has usually no definite limiting membrane, but the walls of the cavity are shreddy, and the surrounding tissues softened; in chronic cases there may be a dense, fibrous sac-wall. The pus is usually greenish in colour, and may be very fœtid. A cerebral abscess may burst into the subdural space, into one of the ventricles, or in very rare cases externally through a carious patch of bone—in such spontaneous cure cannot result, since the exit for the pus is too small. Brain abscess may be associated with inflammation of the cerebral sinuses or membranes.

Symptoms.—Cerebral abscess may remain latent until sudden rupture is followed by death, and the nature of the case is only determined by autopsy. The symptoms are partly dependent on pressure, and may be divided into three stages.

First stage.—The advent of suppuration may be ushered in by a rigor and a slight rise of temperature, though this may remain subnormal throughout; there is early and persistent vomiting, with intense pain in the head, which may be paroxysmal and of crushing severity; the pulse is rapid, and the patient exhibits great prostration and muscular feebleness.

Second stage.—There is general diminution of sensation, in consequence of which the headache becomes less marked and is perhaps but little complained of unless the bone be percussed. The patient is lethargic, apathetic, and sleepy; cerebration is retarded, and he consequently takes some time to comprehend what is said to him, and is incapable of sustained attention; this mental lethargy gradually deepens into coma. The temperature, if previously raised, falls to the normal, or even below it; the pulse is slow and full; the respiration is slow and usually regular, but may be of the Cheyne-Stokes' type, especially if the abscess is in the cerebellum. Muscular weakness is as marked as mental lethargy, but spasm or paralysis of certain groups of muscles may occur, according to the precise locality of the abscess. Papillitis and optic neuritis rapidly supervene. The initial vomiting becomes less or subsides; constipation is almost complete, and there is anorexia.

Third stage.—As the third stage comes on the coma deepens, and there is rigidity and spasm of the muscles. Squint is common. The pulse fails, the breathing becomes quick and ceases before the heart. In all cases of brain abscess the above symptoms will be present, but there may be added symptoms due to the precise situation of the mischief, the observance of which will enable the surgeon to locate it (see p. 232, vol. ii.).

Treatment.—The treatment of brain abscess consists in early trephining and free evacuation of the pus, the point of application of the trephine being determined by the localising symptoms. When the dura mater has been divided and the brain exposed, absence of pulsation may be noted, and is to some extent confirmatory of the diagnosis; the abscess should be sought for by carefully introducing into the brain, in its supposed direction, a fine canula or pair of sinus forceps. When the pus is found the abscess is opened, the pus evacuated, and the shreddy débris removed with a blunt spoon, so as to thoroughly clean the cavity. It should then be washed out with boracic acid solution; if this be thoroughly done a drainage tube need not be used, since the brain, relieved of pressure, tends to bulge and close the space hitherto occupied by the pus. If a drainage tube is employed, Macewen recommends one of decalcified chicken-bone, but its unnecessary use may excite irritation of the brain. The dura mater should be replaced *in situ* but not sutured; the scalp wound is then closed, and an antiseptic dressing applied. Provided no drainage tube has been used, that the temperature remains down, and that the patient's general condition does not otherwise indicate, the dressing may be left undisturbed for ten days; if, however, the conditions attending the operation are such that asepsis has not been thoroughly secured, great care must be taken that the dressings are changed sufficiently often.

In trephining for abscess in the temporo-sphenoidal lobe, the pin of the trephine should be placed on the skull about one and a quarter inch above and behind the centre of the external auditory meatus, and the exploring needle should be directed inwards, and somewhat downwards and forwards, but must not be pushed in further than about an inch. For cerebellar abscess the trephine should be applied about one and a half inch behind the centre of the meatus, and half an inch below Reid's base line (see p. 236, vol. ii.).

INFECTIVE THROMBOSIS OF THE INTRACRANIAL VENOUS SINUSES

Causes.—Infective thrombosis may be due to middle-ear disease or some infective inflammation occurring about the scalp, face, nose, pharynx, or neck; it may also follow a wound of the scalp or compound fracture of the skull if septic inflammation should occur. The inflammation of the sinus and subsequent thrombosis may be due to direct spread from the seat of primary infection; or a distant inflammation may set up phlebitis, which gradually spreads backwards towards the sinus (*retrograde phlebitis*). The lateral sinus is most frequently affected, since, in the great majority of cases, disease of the middle ear is the primary cause.

Morbid anatomy.—The wall of the sinus is inflamed and softened; the endothelium proliferates and desquamates, and the softened wall may give way, but even should this happen, hæmorrhage does not occur, since the sinus is filled with clot. The thrombus, being infected with micro-organisms, rapidly disintegrates, and infective emboli may thus be carried into the general circulation. The end of the thrombus is, however, for a time at least, not charged with infective properties, and hence, the disintegrating process being confined to the centre of the thrombus, a localised abscess may result which is shut off from the circulation. Should infective emboli be carried into the circulation, they will excite acute suppurative inflammation wherever they lodge. As the disease in the sinus progresses it will gradually extend along it, invade those which communicate with it, or pass along the veins from which it receives, or into which it pours, its blood; thus in the case of the lateral sinus, the thrombosis may extend into the internal jugular or mastoid veins, or to the other cranial sinuses. The inflammation of the wall of the sinus may extend inwards to the pia arachnoid, exciting acute leptomeningitis, or, by a further inward extension, abscess of the brain. Extending outwards, the inflammation may give rise to suppuration between the dura mater and the bone; and if the process should have extended along the emissary veins, there may be suppuration along their course. Macewen points out that the bone and soft tissues in the neighbourhood of the inflammatory process may be eroded, disintegrated, and deeply stained a dark green or brown colour; this he attributes to the bacillus pyocaneus, or some other chromogenic organism.

Symptoms.—Infective thrombosis is ushered in by early and repeated rigors, and the usual severe constitutional symptoms characteristic of an acute infective process. There is intense headache and vomiting; the temperature exhibits marked fluctuations, rising perhaps as high as 106° F.; the pulse is rapid, small, and failing. Macewen classifies the symptoms into three groups—as pulmonary, typhoid, or meningeal in type; but at the same time points out that the symptoms characteristic of each of these types are often intermixed.

Pulmonary type.—The general symptoms may merge into the pulmonary type, and do so usually during the second week; the symptoms are then dependent upon the impaction of infective emboli in the pulmonary vessels. There is dyspnœa, and the patient complains of local pain or "stitch" in the side. As successive emboli lodge in the lung these symptoms reappear, and the site of the pain and physical signs will serve to localise their position. Very soon there is prune-juice expectoration, which rapidly become purulent and extremely offensive. There may be localised dulness, and auscultation reveals the presence of coarse râles and other signs indicative of infective pneumonia. Occasionally extension through the diaphragm leads to hepatic abscess. The patient usually dies in from two to four weeks.

Typhoid or abdominal type.—The symptoms of this type so closely resemble those met with in typhoid fever that the differential diagnosis may, for a time at least, be very difficult or impossible. The absence of the characteristic rash and the presence of chronic ear disease and intense headache, which persists even in the presence of delirium, are the main diagnostic signs of thrombosis. The patient rapidly falls into the typhoid state, and vomiting, with persistent diarrhœa, set in; drowsiness becomes lethargy, which, deepening into coma, rapidly terminates in death.

Meningeal type.—This is the rarest type of symptoms. It is usually associated with one of the foregoing. and is dependent upon associated leptomeningitis. There is violent headache, constant vomiting, with high temperature, spasm, and tonic contraction of groups of muscles, great restlessness, and mental agitation. Strabismus is common. The head is sometimes retracted, and delirium deepens into coma. If the patient survive long enough the process will extend to the spinal meninges.

In all cases of infective thrombosis, if the process extends to the emissary veins, there will be œdema, puffiness, pain, and tenderness along the course of the infected vein; and should suppuration occur, the local signs will increase, and fluctuation become apparent. The mastoid vein should be specially examined where it leaves the mastoid foramen.

Treatment.—The preventive treatment consists in the observance of strict asepsis in all injuries of the head, in the antiseptic treatment of ear disease, and those infective processes about the head or face, *e.g.* erysipelas, which may be the origin of the mischief. The general plan of treatment may be best indicated by a reference to that adopted in thrombosis of the lateral sinus. If, in such a case, there is evidence that the process has extended to the internal jugular vein, this should be ligatured in the lower part of the neck, in order to prevent the passage of infective emboli to the pulmonary vessels. The sinus is then exposed through an incision from the tip of the mastoid process to the posterior root of the zygoma, the bone is denuded, and the trephine applied; enough bone must be cut away to thoroughly expose the sinus. As the bone is removed, pus may escape from between it and the sinus. The wall of the sinus is now freely incised, and the disintegrating thrombus removed with a small spoon, or by syringing through the vein from below. Bleeding may or may not occur; but in either case the subsequent treatment is the same. The wound should be plugged with iodoform gauze, in such a manner that the divided wall of the sinus is doubled into the interior, and thus helps to obliterate it. If there be any abscess round a vein to which the process has extended, it must, of course, be opened, treated with antiseptics, and thoroughly drained. These cases are extremely fatal, and nothing short of radical treatment offers a chance of success.

JACKSONIAN OR FOCAL EPILEPSY

Causes.—When any part of the sensori-motor area of the cortex of the brain is the seat of an irritative lesion, the patient exhibits certain symptoms collectively known as Jacksonian epilepsy, the precise nature and sequence of which depend upon the actual seat of the mischief in the area mentioned.

Etiology.—Many different pathological conditions may give rise to Jacksonian epilepsy, and although it is usually easy to arrive at a definite conclusion as to the locality of the lesion, it is often impossible to determine its nature. Sometimes no pathological lesion is found.

Most cases are due to injury; thus there may be a depressed fragment of bone, an old blood clot or blood cyst, adhesion and thickening of the meninges, or a scar in the brain as the result of laceration or hæmorrhage.

In rare cases the fits are reflex, and are due to irritation from a scar in the scalp, or sclerosis of the bone. Jacksonian epilepsy, occurring independently of injury, may arise from the pressure of a tumour, chronic meningitis, cerebral hæmorrhage, thrombosis, or embolism.

Symptoms.—The attack begins with perverted sensation in the part over which the affected area presides; there is tingling or numbness, soon followed or accompanied by muscular twitchings, which are most intense in those muscles connected with the point of greatest irritation, and affect others less strongly.

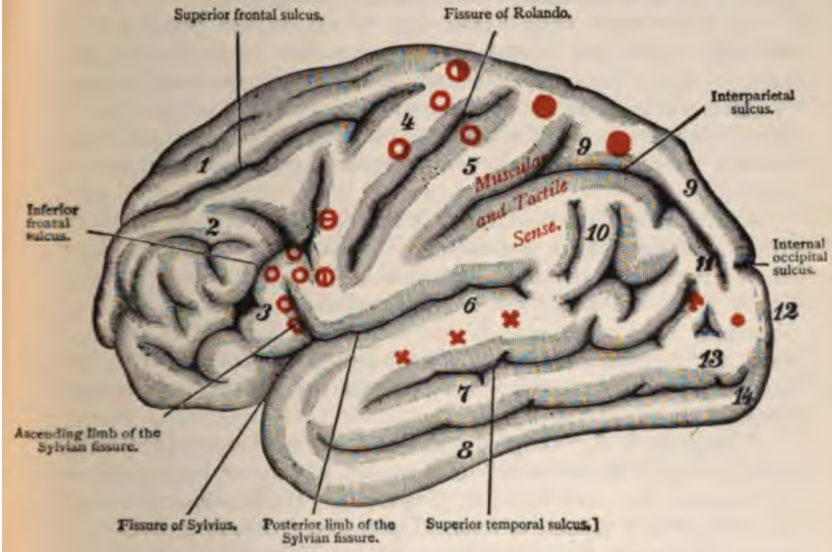
Superior frontal sulcus.
Fissure of Rolando.
Interparietal sulcus.
Inferior frontal sulcus.
Internal occipital sulcus.
Muscular and Tactile Sense.
1
2
3
4
5
6
7
8
9
9
10
11
12
13
14
Ascending limb of the Sylvian fissure.
Fissure of Sylvius.
Posterior limb of the Sylvian fissure.
Superior temporal sulcus.]

FIG. 84.—Diagram of the cerebral cortex and its centres (Tillmans).

1. First frontal convolution
2. Second ,, ,,
3. Third ,, ,,
4. Anterior central convolution
5. Posterior ,, ,,
6. Upper temporal ,,
7. Middle ,, ,,
8. Lower ,, ,,
9. Upper parietal ,,
10. Lower ,, ,,
11. Angular gyrus.
12. Upper occipital ,,
13. Middle ,, ,,
14. Lower ,, ,,

○ In 4 and 5 on both sides of the fissure of Rolando, motor area for the upper extremity.
◑ Motor area partly for the upper and partly for the lower extremity (great toe).
● Motor area for the lower extremity.
⊖ Cortical area for the facial nerve.
⦶ Cortical area for the hypoglossal nerve.
○ (3) Motor aphasia.
× (6) Sensory (auditory) aphasia with word-deafness.
+ (11) Aphasia with word-blindness.
● (12) Region of the visual area.

The attack may at first be limited to one group of muscles, and the convulsions be slight; but as the pathological lesion becomes more marked and advances to adjacent areas of the cortex, other muscles are affected, though at first in a less degree.

Dr. Allen Starr aptly likens this to the ripples produced by throwing a stone into a pond; the greatest effect is produced at the point of impact, the ripples gradually fading away towards the margin.

After a convulsive attack (which is not usually accompanied by loss of consciousness) there may be a feeling of muscular weakness, or even temporary paralysis or anæsthesia from exhaustion of the centres.

If the cortical irritation involves the speech centre, it occasions aphasic epilepsy; if the frontal lobe is the seat of the mischief, there may be temporary mental aberration or delusions; and so on according to the situation of the lesion, the locality of which must be diagnosed by a knowledge of the method of attack, the order in which the convulsions of the different groups of muscles occur, and any special symptoms which may present themselves (see Cerebral Localisation, p. 232, vol. ii.).

Treatment by trephining.—All cases of true Jacksonian epilepsy should be submitted to operation as soon as the locality of the irritation has been definitely diagnosed. If the pathological condition present is capable of removal, permanent cure may result; but in many cases the fits recur after a time. This recurrence may be due to the irritation of the necessarily resulting scar in the brain, or to thickening and adhesion of the membranes. Failure to permanently benefit the patient is, at present, more common than success.

If the epileptic attacks are general, or are due to a cause, the seat of which cannot be duly localised, and especially if there is a history of epilepsy in the family, operative interference is unjustifiable.

MICROCEPHALIC IDIOCY

Causes and effects.—Microcephalic idiocy may be due (1) to a developmental defect of the brain, or (2) to some pathological condition, arising *in utero* or after birth, which causes an arrest of growth of the brain and hence favours premature union of the cranial sutures, thereby preventing any increase of cerebral development even if the pathological condition is itself remediable. In the latter class of cases the surgeon may provide room for the growth of the brain by removing a portion of the cranial vault, as suggested and practised by Lannelongue.

It is obvious, however, that craniectomy is only suitable to certain cases, and the good to be derived from it is very limited in all.

Dr. Allen Starr points out that microcephaly may give rise to one of three types of symptoms—motor, sensory, or mental—all of which may be associated with epilepsy, and may be met with in the same patient, one type usually predominating.

When the motor functions are specially affected, there is infantile cerebral hemiplegia, either dating from birth or coming on soon afterwards, and being dependent on cerebral inflammation or meningeal hæmorrhage due to injury during birth.

The mental symptoms may take the form of simple imbecility, or the child may be merely dull of intellect, troublesome to manage, wayward, and utterly deficient in self-control.

Sensory defects are exhibited as deaf-mutism, blindness, or hemianopsia.

The situation of the lesion, and not its nature, determine which type of symptoms the child presents. The pathological conditions which have been found are atrophy or sclerosis of the brain, hydrocephalus, meningeal hæmorrhage, cysts, meningo-encephalitis, and cerebral softening. In some cases there is merely an arrest of development without any naked-eye changes.

Treatment.—The operation of craniectomy is most safely performed in two or more sittings, a small portion of bone being removed each time. If the whole be taken away at once, the shock is great and may prove fatal. The bone is taken away on one side of the middle line, a strip about half an inch wide being removed in a longitudinal direction. The dura must be opened and the brain examined to discover if the lesion present is amenable to any radical treatment. If the brain be found sclerosed or atrophied, no benefit can be expected. The most hopeful cases are those in which the operation reveals a cyst, an old hæmorrhage, or intracranial tension.

After the operation every care must be taken to improve the child's general condition, and carefully educate him.

At present the real value of craniectomy in these cases is *sub judice*, but its success, in properly selected cases, has been sufficient to foster hopes for the future.

HYDROCEPHALUS

Hydrocephalus may be congenital or acquired. The fluid may be within the ventricles (*H. internus*), or in the sub-arachnoid space

(*H. externus*), the latter being usually secondary to the former. The accumulation of fluid is sometimes acute, *e.g.* in meningitis.

Congenital hydrocephalus is dependent on unknown causes, and is often associated with spina bifida. The head rapidly increases in size, the fontanelles and sutures bulge, and the brain substance suffers proportionately to the pressure to which it is subjected. Congenital hydrocephalus, unless severe in degree, is not incompatible with long life.

Acquired chronic hydrocephalus may be due to meningitis, to obstruction of the veins of Galen, or of the straight sinus by the pressure of a tumour; in other cases no obvious cause is present. The symptoms are those of general compression, the actual cause of which it is frequently impossible to determine. Usually the case progresses to a fatal termination unless the primary lesion causing the hydrocephalus can be removed or cured.

Surgical treatment is adopted with a view to relieving intracranial tension; it is, however, very rarely curative, since withdrawal of the fluid does not remove the disease causing its accumulation. Broca has successfully drained the ventricles of a microcephalic idiot four years of age, whose mental and physical condition was thereby very materially improved. The ventricles may be aspirated by introducing a fine needle into the cavity through the anterior fontanelle near the side so as to avoid injury to the superior longitudinal sinus.

Drainage may be provided through a trephine opening made one and a quarter inch above and behind the external auditory meatus. The needle is then pushed into the brain in a direction towards a point two inches above the opposite meatus, a strand of horse-hair is introduced, and thus drainage is provided.

Keen advises that if the escape of fluid is not free enough the operation should be repeated on the opposite side, and the ventricles occasionally irrigated with warm boracic solution.

In acute hydrocephalus dependent on meningitis, it is proposed to drain the subarachnoid space through an opening in the occipital region, a probe being passed beneath the lower surface of the cerebellum until the escape of fluid shows that the subarachnoid space has been opened. In one case in which I performed this operation in a young child with tubercular meningitis the relief was rapid and very marked, but the child died from the effects of the disease within a short time.

TUMOURS OF THE BRAIN

Varieties.—Dr. Hale White, in a series of 100 cases of brain tumours, found 45 tubercular, 24 glioma, 10 sarcoma, 5 cancer, 5 gummata, 4 cystic, 2 glio-sarcoma, 1 lymphoma, 1 myxoma, and 3 doubtful. Psammoma, cholesteatoma, lipoma, teratoma, and dermoids have all been met with, but are very rare. The precise nature of the tumour in any case must nearly always be merely a matter for conjecture, but the presence of tubercle or syphilis are suggestive.

Seat.—In children most tumours are met with in the cerebral axis or the cerebellum, while in adults the cerebral cortex is a usual situation, and it is to tumours so situated that surgical treatment is applicable. Most tumours are situated in the white substance.

Effects.—The effects produced by any tumour depend on its size, situation, rapidity of growth, and on its precise nature. As a tumour grows it replaces the nervous tissue, which undergoes atrophy, degeneration, and softening. Inflammation of varying intensity may be excited, especially if the tumour itself is of an inflammatory nature (gumma or tubercle), and the process may spread to the meninges, which become adherent. Nerve trunks may be compressed or stretched, or incorporated in the growth; if the latter be so situated that important veins are compressed there will be congestion and œdema. When the tumour is large there may be signs of general compression, and if it is located near the pons, the consequent obstruction of the aqueduct of Sylvius and of the veins of Galen may induce hydrocephalus and further intracranial tension.

Symptoms.—Severe and constant headache, vertigo, vomiting, constipation, optic neuritis, and epileptiform attacks, or paralysis, are the leading features of cerebral tumour, for a full account of the symptoms of which the reader is referred to a work on Medicine. The situation of the pain is no guide to that of the tumour, as it may be referred to some distant part of the head. Certain localising symptoms may indicate the position of the growth; a subcortical tumour may produce local signs similar to those of a cortical growth, but, unlike it, is incapable of surgical removal. Of these local signs, it may be briefly stated that a tumour in the occipital lobe will produce hemianopsia; in the parietal lobe, motor and sensory irritation or paralysis, according to whether the tumour is merely producing irritation of, or has destroyed, the cortical centres; in the frontal lobe, mental lethargy and motor changes; and in the left parietal or left temporal lobes, word-blindness or word-deafness respectively.

When the cerebellum is the seat of the growth the symptoms usually develop rapidly; there is marked vertigo, and as the middle lobe becomes involved, cerebellar ataxia and staggering (often, but not necessarily, to the opposite side) make their appearance. Tumours of the cerebral axis and cerebellum soon affect the nerves, and thus the side on which the growth is present may usually be diagnosed. In the early stages of growth the symptoms are those of irritation only, *i.e.* convulsions and pain along the paths presided over by the part of the brain affected; but later on when the cerebral tissue has degenerated these signs give place to paralysis and anæsthesia.

Treatment.—In view of the fatal issue of cerebral tumour an attempt may be made to remove the growth in suitable cases. Unfortunately the number of these is small—probably not exceeding 7 per cent. Even in cases where the tumour cannot be removed, some benefit has been conferred by trephining and consequent relief of tension.

Trephining is indicated in cases where the position of the tumour can be clearly ascertained by localising symptoms to be in the cortex of the cerebrum; most cerebellar tumours are incapable of removal, and all basic growths, and those of the cerebral axis, are necessarily unfit for operation. Operations on the cerebellum are very dangerous.

The most successful cases are those in which the tumour is hard and not very vascular, or is cystic. Some consider that tubercular masses are not suitable for surgical interference, as they are frequently multiple, and their removal is often followed by a recurrence. If there are symptoms pointing to multiple lesions no operation is justifiable.

In all cases, in view of the uncertainty as to the nature of the tumour, anti-syphilitic remedies should be employed for at least a month before operation, although some surgeons deny their power to cause absorption of cerebral gummata.

THE SPINAL CORD AND ITS MEMBRANES

MENINGITIS AND MYELITIS[1]

Meningitis may arise as the consequence of any damage to the spinal column, but is a rare sequel. The inflammation may begin external to the dura (*external pachymeningitis*), or in the pia mater (*leptomeningitis*). Meningitis may also complicate spinal caries or new growths of the column or cord, and may occur in cases of spina bifida, severe bed-sores, and after the operation of laminectomy. The inflammation may be acute or chronic, suppurative or non-suppurative, according to its cause. When the inflammation begins as a leptomeningitis the cord may participate (*meningo-myelitis*).

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[1] For a full account of these diseases the reader is referred to a work on the Diseases of the Nervous System.

Symptoms.—When the inflammation occurs as a consequence of injury, the symptoms usually make their appearance within a few days. There is considerable radiating pain which is aggravated by movement, and spasm or rigidity of the muscles in consequence of irritation of the nerve roots, but if the patient survive long enough, these signs are replaced by anæsthesia and paralysis as the cord or nerves become compressed by accumulated inflammatory products. There is retention of fæces and urine, followed by paralysis of the sphincters and incontinence. In acute cases, especially those due to septic infection, the temperature may rise even to 108° F. or higher, and marked constitutional disturbance is present. When the inflammation begins external to the dura the pus may find its way backwards, and cause redness and œdema of the skin.

In acute cases the patient usually soon succumbs, but if the inflammation is chronic he may survive, although recovery is incomplete and the patient permanently paralysed as to some of his muscles, and sensory diminution is present.

Treatment.—Absolute rest in the horizontal position is essential. Local cold may be beneficial, and mercury internally is strongly recommended by some. If there is an open wound, and the inflammation is of a septic nature and accompanied by suppuration, free exit must be given to the exudation, and for this purpose laminectomy may be necessary. If the condition becomes chronic, counter-irritation to the spine, combined with the internal use of mercury and potassium iodide, should be the treatment employed.

TUMOURS AND INFLAMMATORY GRANULOMATA OF THE SPINAL CORD AND MEMBRANES

Varieties and situation.—Lipomata and hydatid cysts may originate outside the dura; the former are congenital in origin, and are sometimes associated with spina bifida. Sarcoma, glioma, myxoma, gumma, and tubercular deposits may grow primarily from the pia mater or in the cord. Neuromata of the nerve roots and nerves of the cauda equina are sometimes met with. Neuromata, sarcomata, and gliomata are not infrequently multiple when springing from the membranes or nerve roots, but tumours originating in the cord itself are usually single. Tumours within the spinal canal never attain a large size owing to their unyielding environment.

Symptoms.—The symptoms of tumour of the cord, membranes, or nerve roots are often slow in their appearance, but are gradually progressive in character, and may be suddenly accentuated by the advent of myelitis. When the membranes or nerves are the seat of the mischief the onset of symptoms may be more marked, and the symptoms themselves be more severe, but perhaps not so widespread; they are often, at first at least, unilateral, but ultimately affect both sides, either from direct implication of the cord, or from pressure or myelitis. At first the symptoms are dependent upon irritation of the cord or nerves, later on upon destruction of the nerve fibres.

Sensation is first affected. The patient complains of constant dull aching in the back, accompanied by paroxysmal attacks of burning or gnawing pain which may be of extreme intensity, especially in the case of tumours of the membranes or nerve roots. At the level of irritation there is often a feeling of tight constriction; the pain is not present above this point, but is most intense along the course of the nerves directly implicated; it is also felt more or less in all parts below. Sooner or later the hyperæsthesia is succeeded by anæsthesia as the sensory paths become destroyed; the loss of sensation is usually subsequent to motor palsy, with the distribution of which it corresponds, but when the tumour is situated above the lower dorsal region the sensory symptoms are present on the opposite side, provided the symptoms as a whole are unilateral.

Motion is affected subsequently to the appearance of pain. During the stage of irritation there is muscular spasm or rigidity which may cause contraction of the limbs. The spasm and rigidity occur especially in those muscles supplied by the nerve, the root of which is chiefly implicated, but are also present to a greater or less extent in all parts below the lesion. In unilateral cases the muscular symptoms are on the side of the lesion; but it must be remembered that sooner or later both sides of the cord will be implicated. When the nerve fibres are destroyed the spasm and rigidity are replaced by paralysis, which is gradually progressive and accompanied by rapid and marked muscular atrophy, especially when the tumour is situated in the lumbar region.

The reflexes are lost when the lumbar cord is affected, but when the lesion is higher up they are at first increased and subsequently lost.

Vasomotor and trophic changes, similar to those met with in injuries of the cord, may make their appearance in the later stages (p. 278, vol. ii.).

Diagnosis.—The fact that the symptoms are dependent upon the presence of a growth is inferred from the severe and early pain, with symptoms of irritation of the nerve roots subsequently giving place to those of destruction as the growth increases in size; the absence of signs indicative of caries is confirmatory evidence.

Diagnosis of the seat.—Growths originating within the cord usually produce bilateral symptoms, which begin indefinitely, progress slowly, and are not acute in intensity.

When the membranes or nerve roots are the primary seat, the signs of irritation come on more rapidly, are more severe, and may be at first distinctly unilateral.

The level of the tumour is diagnosed by noting the upper horizontal level of the motor and sensory symptoms, and that the special groups of muscles which may be first affected refer the source of irritation to a particular nerve root. Tumours originating within the cord may be two or three vertebræ above the upper level of the symptoms, owing to the fact that the nerves originate higher up within the canal than the level at which they escape and are distributed; the degree of obliquity varies in the different regions of the column. When the membranes or nerves are primarily affected this difference in the level of the lesion and the symptoms is not necessarily present, for the tumour may implicate the nerve at any part of its course within the canal and not necessarily at its root.

Diagnosis of the nature of the growth.—This is usually impossible, except in the case of syphilitic gummata in which the symptoms will improve under treatment.

Treatment.—In all cases anti-syphilitic remedies must be used for at least a month; but if these fail to cause marked improvement, the propriety of an exploratory laminectomy must be considered, and should, in view of the fatal termination of these cases, be undertaken, provided there is no evidence to show that other tumours are present in the body.

If an operation is contra-indicated, the treatment must be directed towards the relief of pain, the amelioration of any symptom which may develop, and the avoidance of bed-sores and other trophic changes which may occur. The pain is sometimes considerably benefited by laminectomy owing to the relief of pressure, even when it is found that removal of the growth is impossible.

SYRINGOMYELIA

By syringomyelia is meant a condition of dilatation of the central canal of the spinal cord, round which is a gliomatous growth. It is probable that the condition of dilatation is congenital, the new growth being a later epiphenomenon. As the glioma grows it encroaches upon the nervous tracts, destruction of which causes the clinical phenomena. Owing to degeneration of the growth, cavities appear in it. Syringomyelia usually affects the cervical enlargement and the upper dorsal cord, but may extend throughout its entire length.

Symptoms.—The clinical signs usually manifest themselves between fifteen and twenty years of age, and may run a course extending over many years. Muscular atrophy and consequent weakness is present in the parts presided over by the affected portion of the cord, and hence is usually seen in the upper limbs affecting one or both sides, according to the direction and extent of the gliomatous growth. The deep reflexes are exaggerated; ordinary tactile and muscular sensation are generally unaffected, but sensations of pain and heat are lost. Sometimes ordinary sensation is abolished, and this, in conjunction with the loss of the trophic nervous influence, may lead to inflammatory lesions which are, however, painless. There is tenderness and pain over the portion of the column corresponding to the cord lesion.

Joint affections.—The joint affections are very similar in their nature to those met with in locomotor ataxy (p. 179). The joints usually affected are those of the upper limbs, since these are in connection with the cervical enlargement. The articular cartilages and ends of the bones undergo gradual atrophy and wearing away, which may be the leading clinical feature. At the articular margins there is some overgrowth with the formation of osteophytes, and ossific masses may be present in the capsule, ligaments, and periarticular structures which are more or less thickened; the synovial fringes are hypertrophied, and in the movements of the joint may be detached as loose bodies; the atrophied bones may undergo spontaneous fracture. As in tabes, so in syringomyelia, the joint affection is ushered in with sudden painless effusion which may as suddenly disappear, leaving the joint much as it was before. A recurrence of the effusion with gradual progression of the pathological changes induces relaxation of the ligaments, sometimes resulting in spontaneous dislocation. Suppuration may occur, but seldom does so.

Treatment.—The utmost that can be done is to promote the general health by the adoption of ordinary principles. As regards the joint affection the treatment is that of Charcot's disease (p. 181); but should suppuration occur, the joint must be opened and drained. No treatment can benefit the morbid condition.

DISEASES OF THE SPINAL COLUMN

SPINAL CARIES—POTT'S DISEASE

Etiology.—Caries of the spine occurs with about equal quency in the two sexes, and usually makes its appearance between the periods of complete primary dentition and adolescence; as age advances it becomes increasingly rare, but may occur even after middle life, and in such cases may be due to syphilis.

Tubercle is the cause *par excellence*, and it not infrequently happens that the patient bears evidence of tubercular disease elsewhere, such as enlarged cervical glands or chronic subcutaneous abscesses. Spinal caries is, like other tubercular manifestations, especially prone to attack weakly so-called strumous children, the poorer classes rather than the more prosperous, and those living amid the poverty and deficient hygienic surroundings of a large city.

In many cases there is a history of antecedent injury which may, however, have been so trivial that but little attention was paid to it at the time; no doubt traumatism does play a part in determining the development of the tubercular process, though perhaps not such an important part as some suppose.

Morbid anatomy. — Pott's disease usually affects the lower dorsal or dorso-lumbar region, but no part of the column is exempt. The morbid process may begin in one vertebra only, or may start as separate foci of disease in two or more; generally speaking, the prognosis is more hopeful when the disease is limited in extent, even if the actual amount of damage inflicted on any individual vertebra be great. While it is questionable if the mischief can arise primarily in the intervertebral discs, it is certain that the bodies are usually the point of attack, and that the disease nearly always remains limited to them and the discs (Fig. 85, p. 242). This proneness of the bodies to inflammation is partly due to the amount of cancellous tissue present, and partly to the fact that they bear the chief weight of the trunk, and are hence more liable to injury. The inflammation may, and usually does, begin just beneath the periosteum on the anterior surface of the body, but it may start in the centre or posteriorly; not infrequently it is a genuine epiphysitis originating at the epiphysiary line on the upper or lower surface of the body. The neural arches may be secondarily involved, but primary disease in this situation is of extreme rarity.

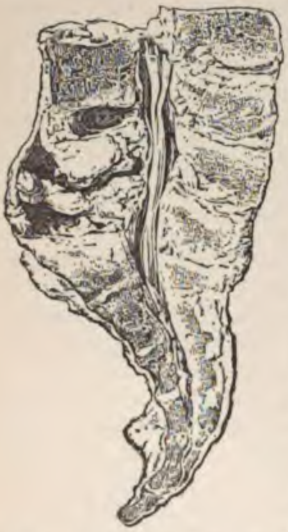

FIG. 85.—Caries of the lower lumbar vertebræ (Westminster Hospital Museum, No. 178D. Drawn by C. H. Freeman).

The cancellated bone is destroyed by the inflammation, and its place occupied by granulation tissue containing typical tubercular nodules. The changes are precisely similar to those described as occurring in rarefactive osteitis (see p. 124). When there are several foci of disease, the affected vertebræ may be riddled with caseous areas, and in macerated specimens present numerous more or less rounded cavities suggesting the appearance of Gruyère cheese. By the coalescence of adjacent areas of disease and by gradual invasion, more or less extensive destruction of the bodies and intervertebral discs occurs, and the strength of the column is proportionately diminished. The destruction tends to spread anteriorly rather than posteriorly, and hence in the majority of cases the spinal canal is not encroached upon, although this may occur as will be presently shown. When the process has advanced, the bodies are worm-eaten in appearance, and the inflamed area is occupied by inflammatory material which, owing to its low vascularity, becomes caseous; it contains particles of destroyed bone, and sometimes small sequestra.

If the disease has been early recognised and carefully treated, and the patient is not strongly predisposed, the caseous mass may, as in tubercular inflammation elsewhere, dry up and become calcareous (*caries sicca*), and the diseased bodies becoming welded together, cure results.

Unfortunately such a favourable termination is uncommon, and in the majority of cases the caseous mass liquefies, and chronic abscess results. Indeed, it is probable that in all cases of spinal caries, whether abscess is diagnosed or not, it is always present, its small size and subsequent calcification preventing its detection. In old cured cases of spinal disease it is not uncommon to find that a "residual" abscess forms, although the spinal condition remains perfectly sound, and it is probable that such abscess is due to suppuration occurring in connection with an old sac, the contents of which had dried up (p. 48, vol. i.).

Suppuration may occur early or late in the disease; indeed, the abscess may be the first condition of which the patient complains, the spinal mischief having progressed so insidiously that it has not even been suspected. The pus is enclosed in a dense wall of fibrous tissue, formed as the result of chronic irritative overgrowth of the surrounding soft structures reinforced by the dense fasciæ, underneath which the abscess may burrow.

The pus burrows and gravitates in the direction of least resistance, and as the disease is usually in the anterior segment of the vertebral bodies the abscess passes forwards and downwards. It may be bilateral or may form only on one side, being prevented from crossing the middle line by the anterior common ligament. Such abscesses are often connected with the actual seat of disease by a narrowed portion, the effect of gravity being to cause dilatation of the lowest part of the sac, which is consequently more or less pyriform (Fig. 89, p. 253). A spinal abscess may be very large and contain pints of pus, curdy material, bony detritus, and perhaps small sequestra; it will gradually approach the surface and burst unless this be anticipated by the surgeon.

The point at which an abscess comes to the surface naturally varies with the situation of the diseased vertebræ, and also with the path along which the pus burrows; this subject is discussed later in connection with caries of individual regions.

When the disease has impaired the stability of the column (and this is often antecedent to suppuration), angular deformity gradually makes its appearance, compensatory curves result, and hence the patient is enabled to maintain the erect posture. The period at which deformity occurs and its degree depend upon the precise seat and extent of the disease. Deformity will be sooner apparent in the dorsal region than elsewhere, because there is, in this situation, a normal posterior curve of the column; in the cervical and lumbar regions the normal anterior curve has first to become obliterated before it is replaced by angular deformity; but this will occur more readily and to a greater extent in the cervical than in the lumbar region, owing to the smallness of the vertebral bodies in the former situation. As regards the extent of the disease it will be found that the angle is most acute when only one or two vertebræ are affected, and more obtuse when many are diseased; it is, of course, increased as the destruction of the vertebræ becomes more complete. The most prominent part of the deformity is formed by the spine of the most diseased vertebra.

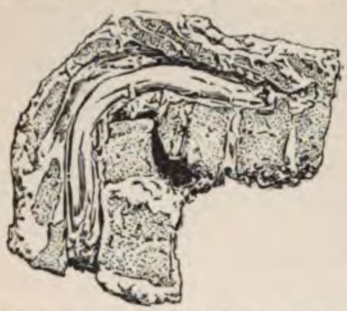

FIG. 86.—Dry caries of the dorsal vertebræ. The destruction of one body and its discs is almost complete. The deformity of the column amounts to a right angle, but the cord is not compressed (Westminster Hospital Museum, No. 179. Drawn by C. H. Freeman).

If, during the progress of the destructive process, the patient has been kept in the recumbent position the deformity will be much less marked, since the weakened part of the spine has been relieved of the weight of the parts above; but even in such cases a certain amount of deformity must be expected, and is produced by the contraction of the muscles consequent on the local irritation, analogous to the flexion of a diseased joint which occurs unless the muscular contraction be counteracted by weight extension or other means. The result of the angular displacement is that the diseased vertebræ are approximated, and if perfect rest be maintained they may become ankylosed and cure result; but the disease is only aggravated if movement is possible, and the carious surfaces rub against each other. It sometimes happens that the gradual bending of the column forces the remnant of a diseased vertebra backwards towards the spinal canal, upon which it may encroach sufficiently to compress or irritate the cord. The cord may be similarly affected by an abscess travelling backwards, or by the extension of inflammation to the cellular tissue between the dura and the bone, and the accumulation here of inflammatory material. In rare cases the caries may extend to the articular processes, and sudden or gradual true dislocation may result with serious compression or irritation of the cord. But although the cord or nerve roots may suffer in any of the ways mentioned they usually escape, since the disease is nearly always confined to the anterior parts of the bodies of the vertebræ, and, moreover, as the cord is much smaller than the canal in which it lies, this can be encroached upon to a certain extent without pressure being occasioned, more especially as the process being chronic, the cord becomes gradually accommodated to the altered conditions of its environment, its movement being facilitated by the fact that the deformity to a certain extent shortens the canal. Individual nerves may be irritated by the pressure of an abscess or inflammatory products.

Repair of the diseased vertebræ is effected by the growth of new bone, which causes firm ankylosis, permanently fixing any deformity which may be present. The inflammatory material, which is not absorbed, dries up and becomes calcareous, and may remain as a harmless foreign body throughout life, or as mentioned above, may subsequently excite the formation of a residual abscess, without, however, the re-establishment of disease in the bones.

Signs and symptoms.—The progress of the disease may be so insidious that the condition is only diagnosed when the formation of angular deformity or abscess or even symptoms referable to the spinal cord attract attention, but fortunately the earlier stages are usually accompanied by evidence leading to a correct diagnosis and prompt treatment.

There is marked **rigidity of the column,** accompanied by **pain** on movement or on percussion along the spines, and there may also be some local **hyperæsthesia** in the neighbourhood of the disease. Sometimes the pain is very slight or quite absent; it is rarely severe. Pain is not infrequently referred along the course of the nerves which may be irritated, and consequently simulates the girdle-pains of tabes dorsalis. Pain may be the only symptom during the early stages of the disease.

In consequence of the rigidity of the column the child's movements are ungainly, stiff, and marionette-like. In walking he keeps the back rigid and only moves the legs, availing himself of any means of support within reach; every movement is deliberately and cautiously performed so that jarring may be avoided. If told to jump or run, the child either refuses or does so in a very feeble manner; in jumping, he, unlike most young children, comes down on his toes and not on the flat of the foot; if his attention be drawn to anything behind him he will, especially if the disease is in the cervical or cervico-dorsal region, slowly turn completely round, but it will be observed that he does not turn his head or rotate his spine; in stooping he bends his knees and thighs but not the back, and if the lower dorsal or lumbar vertebræ are diseased he places his hands upon the upper part of the thighs and slowly slips them down towards the knee as he stoops; by this manœuvre he takes the weight of the upper part of the trunk off the diseased vertebræ. If placed on his back upon the ground he will either remain in that position (perhaps having feebly tried to rise), or will slowly get up, using his hands to do so. The rigidity is especially noticeable when the more movable parts of the column are diseased.

Sooner or later **angular deformity** makes its appearance and steadily progresses unless steps be taken to prevent it. The parents may state that the back has been "growing-out" for some time, but as the child did not complain no special notice was taken of the fact. The angular deformity of caries is diagnosed from the curvature of rickets by its being limited in extent, whereas the rickety curve affects the whole column; moreover, the latter can be overcome by lifting the child by his shoulders and is not associated with rigidity; a similar local deformity is sometimes dependent upon the growth of a tumour.

Sooner or later **abscess** may become evident and gradually increase in size. The directions taken by the pus will be mentioned when caries of the various regions is specially dealt with.

It has already been stated that the **cord and nerves** usually escape, but as has been shown, they may, under certain conditions, suffer irritation and compression which will lead to consecutive myelitis, the symptoms of which are discussed on p. 237. In cases of spinal caries with compression of the cord the symptoms may at first be only marked when the patient assumes the erect posture, *i.e.* when the deformity is most pronounced, and become much less evident when the recumbent position is assumed. In very rare cases complete, or almost complete, paraplegia may be the first indication of the disease; but in the majority of instances there is gradually progressive muscular weakness culminating in paralysis, possibly with rigidity of groups of muscles and increased reflexes; the muscles may, and usually do, retain their electric irritability and waste but little. At first rheumatic or neuralgic pains are often present, but as the pressure persists and increases, diminution of sensation becomes marked. Control over the bladder and rectum may be lost, and in bad cases trophic changes may make their appearance. It is important to note that when the pressure is dependent upon accumulated inflammatory products, even if it cause paraplegia, the symptoms may completely clear up if the inflammation subsides and the products contract and dry up by absorption of the fluid, and hence relieve the compression.

Diagnosis.—The diagnosis of spinal caries presents no difficulty in the presence of angular deformity and abscess, but in its early stages when pain and fixity of the column are the leading features it may be confounded with rheumatism, neuralgia, or spinal tenderness. The fixed pain on percussion or jarring of the spine, the hyperæsthesia elicited by a hot sponge, the rigidity and characteristic bearing of the patient are the main diagnostic features of caries. Neurotic girls and women sometimes present all the symptoms of caries, even to those of compression myelitis, but the absence of any alteration of the normal curve of the spine, the fact that the pain is not always localised to one spot, that it is not elicited by heat, but rather by quite superficial touches, and the general so-called "hysterical" tendencies of the patient, will usually be sufficient to avoid error; in any case in which there is the least doubt the patient should be carefully watched and frequently examined. The history of the case and the predominance of the cord and nerve-root symptoms will serve to distinguish the curvature met with in cases of tumour from that due to spinal caries (p. 239).

As regards the diagnosis of the source of any abscess which may have originated from spinal caries it must always be remembered that dorsal, psoas, iliac, lumbar, and cervical abscesses may originate quite independently of spinal disease, and that an abscess may be "residual" and have formed a long time after the caries has been cured. Psoas abscess may originate from rupture of the muscle, or may be due to the invasion of the psoas by an abscess originating in its neighbourhood, in the pleura, or in the mediastinum. Iliac abscess may likewise be due to hip, pelvic, or sacro-iliac disease, or to suppuration originating round the kidney or gut, or as the result of injury. Thus the discovery of an abscess which is commonly associated with spinal disease is not necessarily evidence of its presence, and if corroborative symptoms are absent, and there is no history which can be of service in clearing up the diagnosis, the contents of the abscess must be examined for particles of bone or sequestra.

Prognosis.—As already stated, the progress of spinal caries is usually very gradual, and even in the most favourable cases the patient will almost certainly be invalided for two years or even longer. If the strumous diathesis be very marked and the child cannot enjoy the very best treatment, food, and fresh air, the prognosis is proportionately grave. Spinal caries is a more serious affection in adults than in children, and is proportionately more dangerous when the higher regions of the column are diseased. The number of vertebræ implicated, as evidenced in some measure by the actual angle which the deformity forms, has an important bearing on the prognosis; as a rule the more acute the angle the more localised is the disease, and hence, other things being equal, the more favourable is the outlook. Early diagnosis and treatment by rest so that all irritation is avoided may limit the disease to the vertebræ first attacked, and in some cases may avert suppuration.

When abscess has formed, the patient's condition is certainly more serious; but, since the introduction of the antiseptic method of treatment, the dangers consequent on suppuration are much less to be dreaded than formerly. If, however, the abscess becomes contaminated by septic material, the patient may succumb to chronic septic intoxication, coupled with the continued drain on the system and fatty and albuminoid changes in the viscera. The subjects of tubercular caries are occasionally carried off by meningitis, general tuberculosis, or some other manifestation of the disease.

Symptoms pointing to involvement of the spinal cord are unfavourable; but, in view of modern operative treatment, and the fact that they may disappear as the inflammatory products become absorbed, such cases are by no means to be despaired of.

In cases which recover the angular deformity is necessarily permanent.

Treatment of spinal caries.—The essential treatment of spinal caries aims at securing complete rest, so that irritation may be reduced to a minimum, and repair of the damaged vertebræ encouraged. So long as the symptoms and pain are acute, the patient should be kept in the supine or prone position on a proper couch. In the case of very young children, who are naturally restless, this will, however, prove unavailing, and they must be at once either put in a light plaster jacket or placed in Phelp's box-splint. Moderate extension is very serviceable, especially in cervical caries, and if there is marked deformity with considerable pain, it, moreover, counteracts the muscular contraction which aids in the production of curvature. Extension is secured by an apparatus taking a fixed point round the chin and occiput, and fixed to the bed above the head. In cervical caries this is all that is necessary, but in dorsal or lumbar caries additional extension must be applied to the legs, as in hip disease. The weight employed must only be sufficient to relieve pain and ensure rest; but no attempt should be made to reduce the angular deformity by this means. As soon as acute symptoms have disappeared, a plaster jacket must be applied in the following way:—The child, clad in a close-fitting soft woollen vest without arms, and pulled well down over the hips, is placed under the tripod; the chin and shoulder straps are adjusted so that he rests on the tips of his toes, and maintains himself in this position during the application of the plaster bandages. A folded napkin should be placed under the vest, over the situation of the stomach, this "dinner pad" being pulled from under the jacket when the plaster has set. The breasts, crests of the ilia, and, if necessary, the projecting portion of the spine, must be protected from pressure by padding. The bandages are now rolled on, extending from midway between the great trochanters and iliac crests to the level of the folds of the axillæ, so that the whole trunk is immobilised and a fixed point is taken below. The jacket may be strengthened by placing strips of tin about three-quarters of an inch broad between the first and succeeding layers of the bandage. These are best placed one on each side of the spine, and one in each mid-axillary line, and should extend the whole length of the jacket. When the jacket is completed and the patient laid upon the back, it is carefully moulded to the trunk in the loins and groins, so that it may fit perfectly. The dinner pad is removed. The recumbent position should be maintained for about an hour, when the plaster will be quite firm. In cases of disease in the cervical and upper dorsal regions, a jury-mast must be fitted with the jacket, so that the weight of the head is taken off the column (Fig. 87). A jacket may be worn for four months, provided the patient be kept clean; but after this time it should be removed and another applied. The beneficial effects of this treatment may be at once apparent. The pain ceases, and the child, rendered much more comfortable and happy, is enabled to get about again with comparative freedom. Immediate reduction of the curvature (*Calot's method*) under an anæsthetic has recently been proposed and practised, the case then being put up in a jacket. Satisfactory results have been reported, but time has not yet shown whether this treatment can be followed with safety and permanent success.

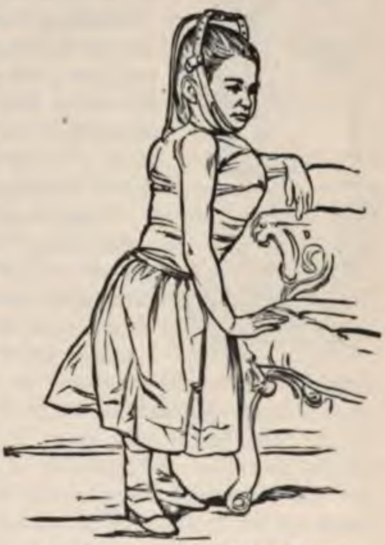

FIG. 87.—The jury-mast (Berkeley Hill).

Jackets of poroplastic felt or leather may be used instead of plaster, or may be worn for a time during the day, when the disease has subsided, and the vertebræ are presumably ankylosed. The length of time occupied in cure necessarily varies, but the jacket should certainly be worn for at least six months after all pain and other symptoms of progressive mischief have subsided. Even in the most favourable case a year's treatment is necessary, and sometimes the period must be much more prolonged.

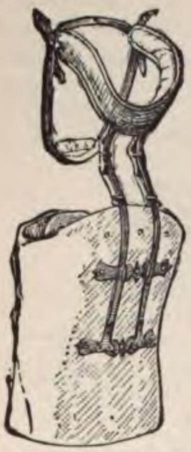

FIG. 88.—Poroplastic jacket with occipital head-piece for cervical caries (Tubby, from Ernst).

During treatment the child must be well fed, warmly clad, and should be removed to the country, preferably to a bracing seaside place. Cod-liver oil, Fellow's syrup, syrup of the phosphates of iron, or steel wine, should be given; the two first being chosen if the child's digestion be good.

Treatment of spinal abscess.—A spinal abscess must be treated, as far as circumstances permit, on the same lines as any other chronic tubercular abscess. Drainage alone is usually of no avail, nor should we expect it to be so, since we know that the wall of such an abscess contains the *materies morbi*, and so long as this be left untreated there can be little hope that mere evacuation of the pus will be beneficial; moreover, it lays the patient open to the dangers of septic mischief and of prolonged suppuration. Drainage must, however, sometimes be resorted to; thus when the treatment to be presently described fails after repeated attempts at cure, and the abscess steadily increasing in size threatens to burst, drainage is the last resource; and under these conditions the abscess must be freely opened in a dependent position, and in one where the greatest safety from fouling of the wound can be secured. In determining the actual point of drainage the following points should be aimed at:—(1) To obtain a dependent opening; (2) in such a situation as to be away from septic sources such as the perineum; (3) to get as near the origin of the disease as possible, so that the lower part of the abscess sac may be able to heal; and (4) that if possible sequestra may be removed from the seat of disease. Thus in psoas abscess the incision recommended by Treves should be employed. The sac is reached through a vertical incision in the loin, parallel with the outer edge of the erector spinæ; this muscle is separated from the quadratus, the posterior surface of which is followed to the transverse processes of the vertebræ, from which the muscle is then separated, and the abscess sac is opened with a pair of forceps. If possible, the seat of disease is explored with the finger. Iliac and lumbar abscesses, which form a diverticulum from a psoas abscess, may be drained by the above incision, or a counter-opening may be necessary.

The following method is to be employed in all cases at first. The abscess cavity is incised in such a position, and to such an extent, that free access to all its parts is obtained without danger of opening the peritoneum, or inflicting damage on important structures. Psoas and iliac abscesses are best opened above Poupart's ligament; this gives plenty of room, and the wound lies, as the patient is recumbent, at the highest point of the cavity, and therefore there is but little danger of leakage when it has been sutured.

The contents are evacuated, and the entire wall carefully and gently scraped with a flushing spoon, the débris being washed away with sterilised water. If any sequestra can be detected, they should be gently removed. Great care must be taken that the curetting is not done with sufficient force to cause perforation of the sac wall. When all parts of the abscess have been attended to, and the water flows away clean, the sac should be dried with rather rough sponges, which will bring away the final débris. Iodoform emulsion is then freely applied to the interior, and the wound accurately closed, while pressure is exerted over the sac so that its walls may be brought in contact and oozing reduced to a minimum. A dry dressing must be applied in such a manner that occlusion of the cavity is as nearly as possible obtained; the collapse of the wall will materially contribute to this end. The dressing should remain untouched for a week or ten days; when it is removed, the wound will be healed, and it may be found that the cavity of the abscess is partially distended with fluid (of a serous nature), which may gradually become absorbed; but if it should persist or increase in quantity, it should be withdrawn by the aspirator. If, when this is done, the fluid is found to be purulent, the treatment will need repeating, and this may be necessary a third or more times. Should failure eventually ensue, the only resource is drainage as above described.

If at the first operation a tube is placed in the abscess cavity and removed the next day, the serous exudate will be drained away and the temporary presence of the tube will not have interfered with the healing process.

Laminectomy in spinal caries.—When there is evidence of gradually progressive compression of the cord laminectomy is called for. The spine is opened at the seat of disease, and the cause of compression dealt with according to its nature (p. 255). If there is an abscess or inflammatory material pressing backwards on the cord, it must be freely sharp-spooned, and the carious area cleared out. If a sequestrum has been displaced into the canal, it should be lifted out, and the carious bone scraped away. The removal of pressure will be followed by great and rapid improvement, and complete recovery may be expected. The operation itself is not dangerous, provided it be carefully performed and strict aseptic conditions be observed. The operation does not appear to impair the stability of the column, contrary to what has been so often stated.

CARIES OF THE VARIOUS REGIONS OF THE COLUMN

Cervical caries.—Disease affecting the upper cervical vertebræ is rare, but very dangerous. It is sometimes distinctly syphilitic in nature, and, unlike caries elsewhere, seems to have a special predilection for the articular surfaces, and consequently gradual or sudden dislocation, with fatal injury to the cord, may occur.

When the cervical spine is diseased the head and neck are kept absolutely rigid, and the patient may support the chin and occiput with the hands. Movement in the lower dorsal and lumbar regions is not impaired, but is always cautious, to prevent undue jarring. Pain is sometimes, though not often, severe, and can easily be elicited by pressure on the vertex of the skull. Owing to the small size of the bodies of the vertebræ, angular deformity soon becomes apparent and may be extreme. When pus is present, the abscess may be retro-pharyngeal and present in the throat, or pass backwards and point behind the sterno-mastoid muscle or more posteriorly. In rare cases the pus, guided by the deep cervical fascia, finds its way into the mediastinum or axilla. Involvement of the cord is a serious complication, and in the upper regions is fatal.

Dorsal caries.—The last two dorsal and upper lumbar vertebræ are the most common situations of the disease; but any of the dorsal vertebræ may suffer. Deformity in the dorsal region is early and marked, since there is normally a posterior curve in this situation and the spines of the vertebræ are long. As a result of the deformity the antero-posterior diameter of the chest is increased, but it is compressed laterally; the sternum is pushed forwards, and the respiratory movements are often shallow and catchy, or laboured. Respiration may be chiefly diaphragmatic. When suppuration occurs in connection with the upper dorsal vertebræ, the abscess often forms posteriorly, and extends to the back along the intercostal vessels; or it may form in the mediastinum and subsequently enter the psoas muscle by passing under the internal arcuate ligament. In rare cases the sac bursts into the pleural cavity or lung.

When the lower vertebræ are diseased psoas abscess is the rule; but lumbar abscess may be secondarily formed as a diverticulum from this or may originate independently.

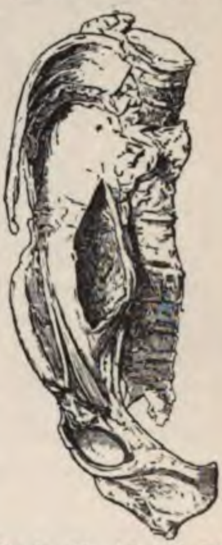

FIG. 89.—The right half of the spinal column below the eleventh dorsal vertebra with the twelfth rib and innominate bone. The second and third lumbar vertebræ are carious and a psoas abscess extends down to the pubic ramus; part of the wall has been removed. The anterior crural nerve lies to the outer side of the sac below (Westminster Hospital Museum, Nò. 178C. Drawn by C. H. Freeman).

Psoas abscess may be bilateral. It is usually constricted where it is in connection with the diseased vertebræ, and again as it passes under Poupart's ligament, should it reach so far. A lumbar or iliac diverticulum may be present. When the abscess passes beneath Poupart's ligament it lies external to the femoral vessels; but should it further increase in size, it will burrow down the thigh, along the course of the profunda artery, and so reach the inner side. It occasionally happens that a diverticulum from a psoas abscess may pass into the pelvis and escape from it through the sciatic notch, or it may burst into the rectum, bladder, or vagina, or on to the perineum. The irritation of the psoas leads to some flexion at the hip joint and pain on walking, and hence the case may superficially resemble hip disease. It must be remembered that psoas abscess is not necessarily of spinal origin; it may originate from injury to the muscle, or an abscess in its neighbourhood, *e.g.* peri-renal, may enter the psoas sheath. When a psoas abscess is small, it may not be detected unless an examination be made under anæsthesia; but if it has reached Poupart's ligament or Scarpa's triangle, the diagnosis is easy. Fluctuation is evident and there is a distinct impulse on coughing.

Lumbar abscess may occur independently of, or in association with, psoas abscess, and like it, is not necessarily dependent on spinal caries. It may occur in connection with disease of the kidney, liver, or spleen, empyema, caries of the ribs or ilium, or of the sacro-iliac articulation, and sometimes is due to a subcutaneous deposit of tubercle or rupture of a muscle.

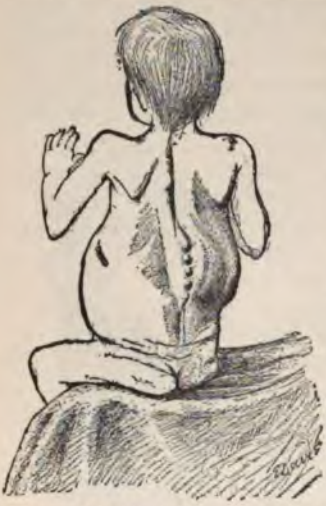

FIG. 90.—Double lumbar abscess from spinal caries in a child aged fifteen months (the mother's hands supporting the child are not shown), (Tubby).

Lumbar caries.—As stated above, spinal caries is most usually met with in the lower dorsal and upper lumbar vertebræ. When the lumbar spine is affected the formation of angular deformity may take some time, since the natural anterior curve in this situation has first to be obliterated; and additionally, the lumbar spines are short and the bodies large. Psoas or lumbar abscess is most usual; but the pus may accumulate in the iliac fossa, or travel downwards into the pelvis, as described under dorsal caries. If cord symptoms are met with, they may be very irregular in distribution, since in the lumbar region the nerve cords are split up to form the cauda equina.

TUMOURS OF THE SPINAL COLUMN

Primary sarcoma may begin in the vertebral bodies. Secondary sarcoma and carcinoma are not uncommon, and an exostosis may spring from some part of a vertebra, usually the body. Tumours may also invade the spine by spreading from the soft structures, and aneurisms of the aorta not uncommonly invade and destroy the vertebral bodies.

Symptoms depend in great measure upon the direction taken by the growth and the degree of impairment of the strength of the column. In cases of malignant disease the progress of the case is comparatively rapid, and the discovery of a primary growth, when the disease is secondary, is of great diagnostic importance. Exostosis progresses very slowly and does not produce any very evident symptoms unless the canal be encroached up. The chief symptoms of tumours of the column are, local lancinating pain and rigidity of the column, with hyperæsthesia over the region involved, gradual angular deformity independently of the usual symptoms of caries, and if the growth presses on the nerve roots or cord, there are the signs of motor and sensory irritation, followed by those of destruction, the symptoms being of the same nature as those met with in tumours growing within the canal (p. 238). Physical examination very rarely reveals any evidence that the signs are dependent upon tumour of the column except in cases where this is involved by the spread of large mediastinal growths.

Treatment is merely palliative, except in cases in which it is probable that the growth is an exostosis invading the canal, and which may possibly be removed by laminectomy.

LAMINECTOMY

Indications.—Opening the spinal canal or laminectomy may be required in some cases of fracture-dislocation, for hæmorrhage within the canal, for compression as the result of caries, or for the removal of a new growth. The advisability of the operation must be determined upon the special features of each individual case; thus in cases of fracture-dislocation the operation is clearly urgently called for, if it is apparent or probable that the spinal symptoms are dependent upon the direct compression exercised by depression of the neural arches (unfortunately but rarely the case), whereas it is not only useless, but its performance would be unjustifiable when the vertebral body is damaged and the cord actually lacerated by a displaced fragment. In caries the operation is called for if gradual compression paraplegia comes on and becomes progressively worse. In cases of tumour laminectomy should be resorted to in order that an exploration may be made and the growth removed if this be found feasible, but it must not be performed if the tumour is secondary in origin, or if there is evidence of multiple tumours within the canal. It must be remembered that compression of the spinal cord is quickly followed by compression myelitis, and in such cases it cannot be expected that mere removal of the compressing force will at once relieve all symptoms; hence the prognosis, in the event of successful removal of such force, must be guarded, since it is time alone which will show how far the damaged cord is capable of recovery; at the same time, it may safely be said that if the operation has not been too long postponed, ultimate complete recovery may be hoped for.

The operation.—The situation of the lesion having been carefully determined, an incision is made in the middle line and the neural arches are denuded by the knife and elevator; there is often free bleeding which can usually be arrested by pressure. The canal is carefully opened by the saw and bone forceps; at first only one neural arch should be removed, followed by others which may impede free manipulation and examination. If nothing be found outside the dura, this should be carefully opened in the middle line and the cord examined; at the completion of the operation the dura may be sutured with chromic gut.

A spinal abscess pressing backwards can be exposed by carefully hooking aside the dura mater, and must be sharp-spooned, all sequestra removed, and the cavity treated with iodoform emulsion; care must be taken not to damage the nerve roots.

A tumour must be gently lifted out without the infliction of damage to cord or nerve roots. Thus each lesion can be treated on ordinary surgical principles. The external wound should be closed and drained for a few days. If the dura has been opened, a considerable flow of cerebro-spinal fluid must be expected.

Results.—The result of laminectomy depends upon the actual condition for which the operation is undertaken, and the success which has been attained in the removal of the compressing agent.

In cases where the operation is performed for the mere relief of pressure which has not excited grave secondary inflammation perfect cure may be expected, but if there is associated chronic myelitis with degeneration of the nerve tracts, the most we can hope for is some improvement in the symptoms. The best results are obtained in cases of spinal caries.

In fracture-dislocation it is very rarely that laminectomy can do much good, or indeed that its performance is warranted, since in these cases the nervous symptoms are usually due to crushing lesions of the cord which have ensured permanent destruction.

CHAPTER X

DISEASES OF THE NOSE AND NASO-PHARYNX

FOREIGN BODIES AND CONCRETIONS IN THE NOSE

FOREIGN bodies of various kinds may be purposely introduced into the nose by children and idiots. They may also become lodged in the nasal cavities as the result of injury, and may remain for a very long time before their presence is detected.

Foreign bodies purposely introduced are usually found in the inferior meatus, and if small they may be expelled during an attack of sneezing which the irritation caused is likely to produce, or they may pass backwards to the pharynx and be swallowed. The symptoms are usually sneezing, repeated cold in the head, pain, obstruction to respiration, and muco-purulent discharge which may be very fœtid. The two last symptoms are unilateral. In many cases the patient has been vainly treated for months or years for "ozœna." On examination by anterior rhinoscopy the body is usually easily found and may be removed by forceps, snare, or hook. If any difficulty is found in locating or removing the body the patient should be anæsthetised or the nose freely sprayed with cocaine, so that a more complete examination can be conducted, and the finger may be introduced into the posterior nares.

Rhinoliths.—A calcareous concretion may form round a foreign body or a plug of mucus and may attain sufficient size to completely block the nose. The calculus consists mainly of phosphate and carbonate of lime and magnesia, and chloride of sodium, with about 25 per cent of organic matter. These concretions are usually found in the inferior meatus and give rise to the same symptoms as a foreign body. They must be broken up and removed.

EPISTAXIS

Causes.—Bleeding from the nose may be due to traumatism, venous congestion, or local mischief, or may occur in the course of some general disease. Traumatic hæmorrhage may be caused by violent sneezing, a blow, direct injury to the mucous membrane by things thrust up the nose, or by fracture of the nasal bones or of the anterior portion of the base of the skull.

Venous congestion is the cause of the bleeding which so frequently occurs spontaneously in the young; it may also be dependent on any state, *e.g.* disease of the heart, liver, or kidneys, which causes widespread venous congestion. Hæmorrhage may also occur in anæmia, scurvy, hæmophilia, and purpura, or during the course of one of the acute specific diseases. Local causes of hæmorrhage should be sought in some ulcerative affection of the nasal passages, in adenoid vegetations, in sarcomatous growths of the nasal fossæ, and in cases of so-called naso-pharyngeal polypus; in the last the bleeding may be so frequent and profuse as to cause death.

Treatment.—If any local cause exists, it must be removed as soon as possible.

In the great majority of cases the bleeding is but slight in amount and stops spontaneously, the flow of blood being often rather beneficial than otherwise. If the bleeding be sufficient to require active treatment, the patient should be placed on his back with the arms above the head, the collar should be loosened so that the cervical veins may be relieved of all pressure, and an ice-bag may be placed over the forehead and root of the nose. If this means fails ice-cold water should be injected into the nostril, or a solution of tannin or hamamelis may be employed. In one very bad and persistent case occurring in an elderly gentleman I succeeded, after several times plugging the nares without avail (the bleeding recurring as soon as the plugs were removed), in arresting the bleeding by the inhalation of turpentine, after it had persisted for ten days. Gallic acid and hamamelis internally and ergotine hypodermically may also be tried. If other remedies fail the posterior nares must be plugged and, if necessary, the nostril also. The posterior nares can be readily plugged by a catheter passed into the pharynx along the inferior meatus; a thread is then passed through the eye and the instrument is withdrawn so that the thread passes through the mouth and nose; a suitable plug of lint dusted with iodoform or saturated with a solution of Listerine is then attached to the end of the thread projecting through the mouth, and this is drawn into the posterior nasal aperture by the thread passing along the nostril; the two ends are then tied over the lip. The plug should be removed in about twelve to sixteen hours, as it is liable to become very foul; if necessary, a second must be introduced.

If the patient has lost sufficient blood to imperil his life, salt solution must be injected into the veins.

SYPHILITIC AFFECTIONS OF THE NOSE

The mucous membrane of the nose may participate in the erythema which attacks the throat during the early secondary stage. In the congenital disease mucous tubercles are common, and owing to want of development or actual destruction of the nasal bones the bridge of the nose becomes sunken (see p. 202, vol. i.).

In the tertiary stage gummatous inflammation of the mucous membrane and periosteum may result in softening and breaking down with consecutive necrosis of the bones. The mischief may be extensive and lead to more or less complete destruction of the septum, turbinals, and ethmoid, or to perforation of the palate; such perforations are usually rounded or oval in shape, and situated near the middle line far back on the palate. If the nasal bones and septum are destroyed, characteristic deformity is produced owing to the sinking of the nose. These conditions cause dryness about the nasal cavities, soon followed by an intensely fœtid discharge; on examination ulcerating patches covered with foul crusts will be seen and bare bone will be felt on probing. The soft palate may be partly destroyed and become adherent to the pharynx. The voice becomes gruff and is characteristically altered if the palate be perforated.

The treatment is that for syphilis, combined with local antiseptic sprays and the removal of loose sequestra. If the palate has been perforated, no attempt must be made to repair the mischief until all morbid action has subsided for some weeks.

DISEASES OF THE NASAL SEPTUM

Irregularities of the nasal septum are not uncommon, but unless extreme do not give rise to symptoms necessitating surgical interference. The irregularity may be merely an exaggeration of the normal slight deflection of the septum to one side, or it may result from injury to and displacement of the cartilage, or to bony or cartilaginous spurs and outgrowths. If the projection causes obstruction to respiration, or sets up irritation or ulceration, the portion should be removed by a fine saw after a small flap of mucous membrane has been turned upwards; the flap falls over the seat of the operation, and may be kept in place until union occurs by means of a strip of aseptic lint rolled round a piece of catheter, which is introduced into the nostril.

Abscess of the septum may be associated with bone disease, or may result from injury. It causes pain and swelling, with proportional nasal obstruction; the abscess may burst, or may perforate the septum and burst on each side. The treatment consists in free incision and the employment of antiseptics; if the bone is found to be diseased, the treatment for that condition must be adopted.

Hæmatoma and **new growths** of the septum are occasionally met with.

DISEASES OF THE ACCESSORY SINUSES

The frontal, sphenoidal, and ethmoidal sinuses are liable to conditions similar to those occurring in the antrum (see p. 317, *et seq.*), but they are much more rarely involved. Inflammation and suppuration may result by extension from the nose or throat, from the presence of a new growth, or from obstruction to the outlet leading to retention of mucus within the sinuses.

The diagnosis is difficult. The patient may complain of constant and severe headache, with a discharge of pure pus from the nose, which will be found to come from high up; the discharge may, however, be the only symptom. As the disease progresses the brain and eye may be affected, especially in the case of the ethmoidal and sphenoidal cells; when the mischief is in the frontal sinus there may be distinct bulging over the brow, or the pus may erode the posterior wall of the sinus and cause brain symptoms. In some cases there is high fever, with delirium and severe constitutional symptoms, especially if the escape of pus be prevented. Septic infection may occur unless the nasal cavities be kept perfectly clean. In all cases the antrum should be carefully examined.

The treatment consists in the use of antiseptic sprays and douches, and the insufflation of iodoform. If the seat of the mischief is diagnosed, the sinus must be laid open and washed out. The frontal sinus is readily exposed above the brow, but the ethmoidal and sphenoidal are much more difficult and dangerous of access. To reach these a good light is essential, and the operation is much facilitated if the nose is turned upwards as described at p. 268. If a polypus or other tumour is found it must, of course, be removed, and the subsequent treatment of the case is conducted on the same lines as for empyema of the antrum.

HYPERTROPHIC RHINITIS—FOLLICULAR PHARYNGITIS

These conditions are usually associated and occur as the result of repeated attacks of acute rhinitis or cold in the head, or from constant irritation of the mucous membrane, as by tobacco-smoke. In some cases the condition seems to be constitutional, and old adenoid vegetations are doubtless responsible for many cases of follicular pharyngitis. The mucous membrane of the nose, especially that over the turbinals, is thickened and granular, and cystic swellings may arise in connection with the glands and follicles. True mucous polypi are often associated.

Signs and symptoms.—Owing to the swelling of the mucous membrane there is considerable difficulty in breathing through the nose, which may be temporarily much aggravated by congestion. The patient breathes through the mouth, which is more or less open; the tongue becomes dry, and the mucus at the back of the throat is sticky and ropy, and can only be brought up by hawking; this is especially the case in the morning. The patient cannot speak distinctly; his voice is muffled and nasal, and characteristic of obstruction. There may be a good deal of sero-mucoid discharge from the nose, which may have a fœtid odour to the patient but not to those round him; at the same time, the sense of smell is diminished, and in bad cases may be quite absent. Deafness is common. On examination, the mucous membrane, especially that over the inferior turbinates, will be found to be swollen red and granular; the pharynx is congested, the veins are prominent, and the enlarged follicles are seen studding the surface, which is more or less covered with adherent, dark-coloured, stringy mucus.

Treatment.—All sources of irritation must be avoided, and the nasal cavity should be irrigated twice daily with a solution of boracic acid or bicarbonate of soda (5 gr. ad ℥i.). When the obstruction is sufficiently severe, the thickened mucous membrane (rendered anæsthetic by cocaine) should be cauterised with the galvano-cautery, or may be painted over with chromic acid (10 per cent) or glacial acetic acid. Removal of the turbinals is practised by some, but on what grounds it is difficult to see, since the mucous membrane covering them can be itself treated and the bones are not diseased. Temporary congestion of the mucous membrane may be quickly subdued by the application of a 5 per cent solution of cocaine.

Associated pharyngitis must be treated by the local application of astringents such as tannic acid or alum, either by brushing or by means of a spray. Chloride of ammonium vapour is very useful. If the follicles are much enlarged, the most prominent ones may be destroyed by the galvano-cautery under cocaine; this should be done in several sittings, so that the reactionary inflammation may be reduced to a minimum. The follicles may also be destroyed by the application of nitrate of silver or chromic acid fused on a probe. Fresh air, good food, and tonics are most necessary.

ATROPHIC RHINITIS

Repeated attacks of rhinitis may lead to fatty degeneration and atrophy of the mucous membrane rather than to hypertrophy. The mucous membrane becomes thin, shiny, and stretched, and the nasal cavity is thereby rendered unduly large. There is a sense of dryness and irritation about the nose, and a thick discharge of a muco-purulent nature; this may form large, hard, and adherent crusts, which are attached to the mucous membrane, and often conceal superficial erosions. As a rule, these crusts and the discharges decompose, and those with whom the patient comes in contact are only too conscious of the horrible fœtor of his breath, while he himself cannot appreciate it, owing to the sense of smell being lost (*ozæna*).

Treatment.—The nasal passages must be kept clean and aseptic so far as possible. A nasal douche of boracic acid solution, Condy's fluid, or Listerine should be used two or three times a day; creasote vapour not only materially diminishes the fœtor but also prevents, to some extent, the formation of the crusts, the same end is also attained by a spray of menthol dissolved in oil. Iodoform and boracic acid may be used as snuffs during the day. Residence in country air, good food, iron, cod-liver oil, and general tonic treatment should be prescribed.

ACUTE PHARYNGITIS

Acute catarrhal pharyngitis is the ordinary sore throat, and needs no further mention. An acute spreading form of an erysipelatoid nature occasionally occurs, and may spread to the glottis; this may prove a very serious affection, not only on account of the severe constitutional symptoms but from the danger of involvement of the larynx. There is considerable pain, dysphagia, and dyspnœa; the glands in the neck are enlarged, and the constitutional disturbance may be very severe. On examination the fauces and pharynx will be seen to be much swollen and of a scarlet colour. The treatment consists in painting the part with astringents and the use of steam; if dyspnœa is urgent, laryngotomy must be at once performed. Scarification is not to be recommended.

RETRO-PHARYNGEAL ABSCESS

Retro-pharyngeal abscess may occur in connection with spinal caries, or may be of a more acute nature. The acute form is usually met with in children, and is due to suppuration connected with the lymphatic glands, one of which lies on each side of the middle line behind the pharynx. The abscess may occasion very urgent dyspnœa, and is readily detected on examination; the glands in the neck are often enlarged. The treatment consists in opening the abscess through the mouth or behind the sterno-mastoid. The latter plan should always be adopted when the abscess is due to spinal caries or to tubercular mischief in the lymphatic glands; the incision is carried along the posterior edge of the muscle, the deep fascia divided, and the vessels and nerves are hooked forwards. When the abscess is reached a pair of sinus forceps should be pushed into it and opened; the cavity must be carefully sharp-spooned and drainage employed.

ADENOID VEGETATIONS IN THE PHARYNX

Adenoid vegetations of the pharynx consist in an overgrowth of the lymphatic tissue which forms the pharyngeal tonsil, and is present in the fossæ of Rosenmüller close to the Eustachian tubes. Adenoids are peculiar to young children, and are rarely met after the fifteenth year; many members of the family are often affected, and the condition appears to be to some extent hereditary. The overgrowth may be slight or may completely block the air passage, and encroaching upon the Eustachian tube, set up secondary ear-mischief. Adenoids may be soft, easily detachable, and very vascular, or hard and dense; the mucous membrane is usually thickened. The tonsils are frequently enlarged.

Signs.—In a well-marked case the physiognomy of the child is pathognomonic. He looks and often is mentally deficient; the mouth is constantly half open as the breathing is mainly oral; he breathes heavily, snores at night, and wakes in the morning with a clammy or dry mouth. Thick sticky mucus accumulates in the throat and causes the child much inconvenience; he frequently attempts to clear the throat. Deafness is nearly always present in bad cases, and there may be tinnitus. Epistaxis occasionally occurs. The voice is characteristically nasal. The symptoms of nasal obstruction are worse in damp cold weather owing to temporary congestion of the mucous membrane and adenoids; frequent colds in the head are common. If the case is not treated, the long-continued respiratory difficulty gives a peculiar pinched-in appearance to the alæ nasi; the chest is ill-developed, and the general growth and health of the child are retarded to a marked degree. Examination of the pharynx by the finger will readily confirm the diagnosis, and the finger often comes away covered with blood-stained slimy mucus.

Treatment.—After adult life adenoids tend to atrophy and disappear, but in view of the fact that their presence during the period of active growth interferes with the development of the chest and the general health, and may lead to ear-disease, and that their atrophy is frequently the precursor of chronic pharyngitis, it is imperative that they should be removed. Their removal is best effected under a general anæsthetic by Gottstein's curette. The patient's head should hang over the end of the table and be turned to one side so that the blood (bleeding is often very profuse) may run out of the nostril or gravitate to the cheek, from which it can be easily removed by sponging. The hair may be kept clean by covering the head with a cap made of protective. When the curette has removed the great bulk of the growth, the fossæ of Rosenmüller should be finally cleared by the finger-nail, and any adenoids which have escaped the curette should be similarly removed. The bleeding can be easily arrested on the completion of the operation by pressing the soft palate against the pharynx with a sponge, and at the same time closing the nostril with the finger and thumb for a few seconds. The anæsthetic should not be pushed deeply, for if the child is only just under when the operation is begun, he will be able to cough up a considerable quantity of the blood in his throat. The friends should be always warned that if any vomiting occurs, a good deal of blood which has been swallowed will be brought up. No after-treatment is either necessary or advisable beyond keeping the child in a warm room for a couple of days. If there is much soreness about the throat, the food should be of a fluid nature until this has subsided. Adenoids occasionally recur and the operation must be repeated. If the tonsils are enlarged, they should be first removed, and if the child is very young or weakly, the adenoids are better left alone for a few days after this operation. The improvement in the hearing and general health after removal of adenoids is often rapid and surprising.

TUMOURS OF THE NOSE

LIPOMA NASI

Lipoma nasi is an overgrowth of the skin, connective tissue, and sebaceous glands, which latter may attain a very large size. The condition may be uniform, but is usually more or less lobulated; it rarely affects more than the alæ of the nose, and does not extend to the inner surface (Fig. 91, p. 266). The enlargement is of a bright red colour, and is dotted over with small pits, indicating the situation of the sebaceous glands. The condition is almost confined to males; its causes are unknown, but probably dyspeptic trouble is largely responsible, and chronic alcoholism is sometimes associated. The disease causes much disfigurement and mental worry to the patient, who is fearful of the remarks of the ill-natured.

Treatment.—The nose may be restored to its normal condition by operation, the results of which are surprising and very gratifying to the patient (Fig. 92, p. 267). The patient being anæsthetised, the nares are plugged with small sponges to prevent the blood passing down the throat; the hæmorrhage is very free, but may be arrested by pressure with hot sponges. The redundant tissue is cut away with a sharp knife, care being taken that the knife is not carried too deeply—in point of fact the nose is really pared down to the required shape and size. A dressing of boracic acid ointment is applied, and may be changed once or twice daily. Healing is very rapid, and is usually complete in a week or ten days; as the bases of the glands are left, their epithelium grows up and helps in covering the surface.

NASAL POLYPI

Mucous polypi of the nose may occur at any age, but are rare before puberty. Their causes are unknown; they sometimes occur in association with chronic hypertrophic rhinitis, but the thickening of the mucous membrane in the latter disease is not to be confounded with them.

Morbid anatomy.—Mucous polypi may be quite small or attain a considerable size; they are nearly always multiple and may fill the nasal fossæ, and even project from the nostril or into the pharynx. Polypi grow from the outer wall, usually round the middle turbinate bone (Fig. 93, p. 268); they may also spring from the roof of the nasal cavity, but never from the septum. The tumours have the microscopic and physical characters mentioned on p. 240, vol. i. They spring from the mucous and submucous tissue, have a complete covering of mucous membrane, and are covered with ciliated epithelium. They are usually pedunculated, but the pedicle is often long and narrow, so that they seem to be sessile. The base of the growths is very vascular. Similar polypi are occasionally found in the antrum and accessory sinuses.

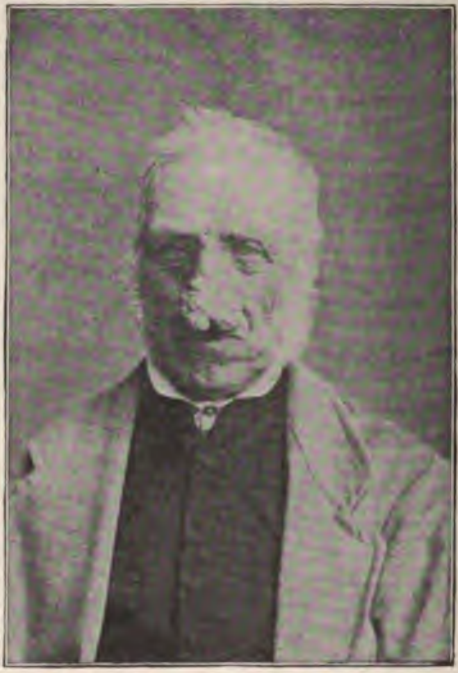

FIG. 91.—Lipoma nasi.

Signs.—The signs are those of nasal irritation and obstruction, which may be bilateral. All the signs are worse in damp weather, owing to the swelling of the polypi from imbibition of moisture and possible congestion.

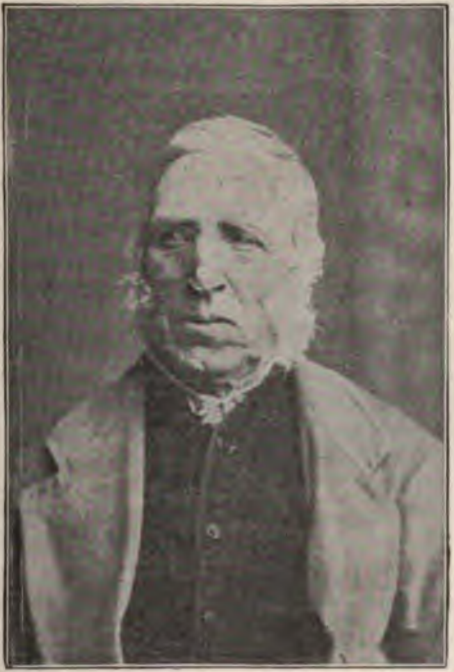

Fig. 92.—The same case as Fig. 91, three weeks after operation as described in the text.

The patient complains of a feeling of stuffiness and inability to breathe easily when the mouth is shut; there may be repeated attacks of cold in the head; fits of sneezing and irritation are common, and there may be a profuse mucus discharge. Asthmatic attacks are sometimes directly traceable to nasal polypi. The voice has a nasal twang, and the patient breathes heavily during the day and snores at night; he frequently wakes with a dry tongue, owing to his sleeping with the mouth open. The sense of smell is much impaired, and may be almost destroyed. Examination by anterior rhinoscopy will reveal the polypi, unless they are in association with chronic hypertrophic rhinitis, but the thickening of the mucous membrane in the latter disease is not to be confounded with them.

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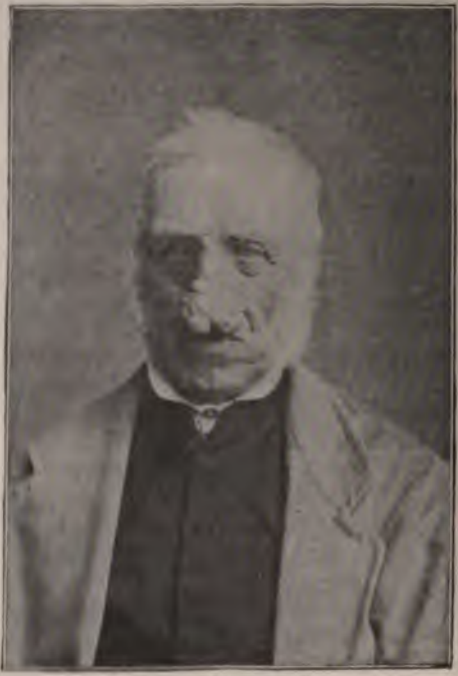

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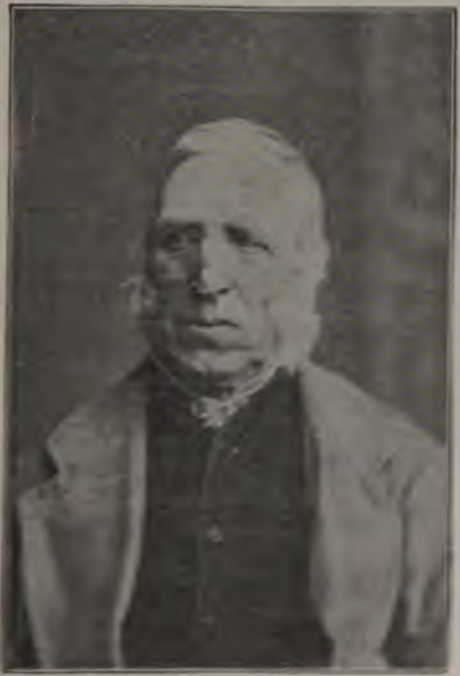

FIG. 92.—The same case as Fig. 91, three weeks after operation as described in the text.

far back and high up, in which case they may be detected by the finger behind the soft palate, or by posterior rhinoscopy.

Treatment.—Complete removal is the only remedy. This may be done under a general anæsthetic if the patient is nervous or the polypi be numerous, or after freely spraying the nose with a 10 per cent solution of cocaine. Avulsion with forceps causes considerable bleeding, and even under cocaine is painful; it must be done under a strong light so that the polypi are clearly seen, or considerable and unnecessary damage may be inflicted; when the base of the polyp has been grasped by the forceps it may be torn off by a twisting action, by this means the turbinate bone is often removed, and many growths may come away together.

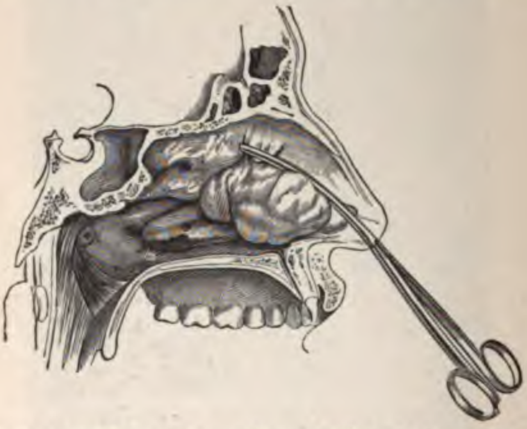

FIG. 93.—Mucous polypus of the nose, the pedicle seized with forceps (Fergusson).

If the snare is preferred, the cold or electric wire may be used; this method has the advantage of causing less bleeding and pain, but unless great care to destroy the base of the growth be taken, recurrence must be expected. In very extensive cases the growths are best removed by Rouge's operation, which consists in detaching the upper lip from within the mouth, dividing the septum backwards and upwards, and thus gaining a free entry into the nose; the lip heals well without deformity. When the polypi are situated far back, the finger passed behind the soft palate into the posterior nares will afford considerable help in their removal. After removal of the polypi the nose should be douched twice daily with boracic solution, Condy's fluid, or Listerine, and a little iodoform should be insufflated. Recurrence is not uncommon, and may be due to the development of fresh growths, to incomplete destruction of the bases of those submitted to operation, or to the fact that some have been overlooked. When numerous polypi are present the highest ones may be tightly jammed towards the roof, and when the lower growths have been removed these may fall down, and hence it sometimes appears as if new growths had sprung up with extraordinary rapidity.

TUMOURS OF THE NASO-PHARYNX

Epithelioma is occasionally met with. The patient complains of pain and difficulty in swallowing, and may bring up blood. Examination with the mirror or finger will determine the nature of the case, which will be further confirmed by the mass of glands in the neck, the enlargement of which may indeed be the first sign to attract attention. Death results from exhaustion and semi-starvation, or from hæmorrhage from the internal carotid. Gastrostomy gave much relief in a case under my care.

Fatty tumour.—This growth sometimes occurs in the pharynx; a very beautiful specimen, which caused death by sudden suffocation, is preserved in the Museum of the Westminster Hospital (No. 422).

NASO-PHARYNGEAL FIBROMA AND SARCOMA

Fibromata or fibroma-sarcomata usually occur in males between fifteen and twenty years of age. The causes are unknown.

Morbid anatomy.—The tumour springs by a single broad pedicle from the periosteum of the basilar process and pushes in front of it the mucous membrane of the pharynx. The pedicle of the tumour contains numerous and large vessels, and the mucous covering is also richly vascular, the veins, which are not infrequently varicose, being the source of the bleeding which forms a prominent clinical feature. The mucous covering may become superficially ulcerated, or more extensive destruction may occur from sloughing, and subsequent false pedicles may form from union of patches of ulceration with similar patches on the parietal mucous membrane. As the tumour grows it becomes much lobulated, and processes may extend down the pharynx, into the nose, the antrum, the sphenoidal sinus, the frontal sinus, the orbit, and even into the cranial cavity after absorption of the bones has taken place; extension to the temporal fossa and cheek is not uncommon (Fig. 94), and the auditory passages may also be invaded through the Eustachian tube.

Signs and symptoms.—The early signs are often trivial, and are not infrequently assigned to other causes. Repeated attacks of sneezing and cold in the head first attract attention, and their real origin is often not ascertained until epistaxis leads to a careful examination. The bleeding is repeated, and may be so severe as to be a serious danger. The patient complains of nasal obstruction, a frequent desire to blow the nose, some difficulty in breathing, and perhaps alteration in the voice. As the tumour increases in size these symptoms become more marked and the general signs are similar to those met with in adenoids. The subsequent signs depend upon the direction taken by the growth; but radiating pain is nearly always present owing to the pressure exercised by the growth on the fifth nerve. Growing into the nasal cavities the obstruction may be complete, and the bridge of the nose being broadened by pressure makes the patient "frog-faced"; the tumour will be clearly seen by anterior rhinoscopy. There may be a fœtid sanio-purulent discharge from the nose in consequence of ulceration.

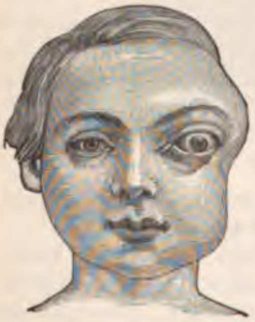

FIG. 94.—Naso-pharyngeal polypus of the left side with a retro-maxillary and orbital prolongation (Tillmans).

Extension to the sphenoidal sinus is almost constant if the tumour has attained a large size, but it can rarely be diagnosed; if the thin plate of bone between it and the base of the skull gives way, the tumour grows into the cranial cavity and causes severe headache, drowsiness, and ultimate coma from pressure, or perhaps acute basal meningitis.

Invasion of the orbit through the spheno-maxillary fissure (Fig. 94) causes proptosis, dilatation of the pupil, diplopia, and ultimate blindness, and sometimes sloughing of the cornea. If the growth extends to the tympanum through the Eustachian tube, deafness and a sanio-purulent discharge from the ear will result as the membrane becomes perforated. Dysphagia and dyspnœa increase as the tumour grows downwards; it bulges the soft palate forwards and may be clearly seen behind it. The tumour is easily recognised by the finger behind the palate.

Course and progress.—If the tumour is a simple fibroma, it steadily but slowly increases in size, although cases have been recorded in which spontaneous atrophy or cure by sloughing has occurred. Sarcomatous elements in the tumour entail more rapid growth and extension and more profuse bleeding.

Death may result from septic lung complication, from repeated or profuse bleeding, or from meningitis excited by invasion of the cranial cavity.

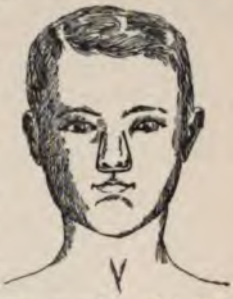

FIG. 95.—Line of incision round the nose in Lawrence's operation. The nose is turned upwards after dividing the nasal process of the superior maxilla on each side and breaking the nasal bones. The nasal septum is divided obliquely upwards and backwards, and the posterior part of it is removed so that free access to the roof of the pharynx is obtained.

Treatment.—Complete removal of the tumour with destruction of its pedicle must at once be undertaken. Removal by avulsion is dangerous on account of the bleeding, and it does not ensure removal of all the pedicle; the same applies to the use of the wire loop. Of the many operations which have been devised for giving free access to these growths, I think Lawrence's method of turning up the nose is the best and the least likely to cause serious shock or subsequent deformity. Free access having been thus obtained the tumour may be tolerably easily dislodged from the sinuses, etc., into which it may have grown, and the pedicle may be safely separated by the thermo-cautery. Unless the pedicle be completely destroyed recurrence is very likely to occur, since in point of fact only part of the tumour has been removed. The liability to recurrence is necessarily greater if the tumour is partly sarcomatous. Recurrence should be carefully watched for and immediately dealt with by operation.

CHAPTER XI

INJURIES AND DISEASES OF THE EAR[1]

THE AURICLE AND EXTERNAL MEATUS

HÆMATOMA AURIS

HÆMATOMA AURIS may be due to injury. It is not uncommon in lunatics, in whom it appears to occur spontaneously. An oval elastic swelling quickly forms without pain. As the blood clot shrinks during the process of absorption, marked deformity of the auricle may occur, as is not uncommonly seen in prize-fighters. Perichondritis is a commonly associated condition, and increases the deformity. Suppuration is rare. The treatment consists in the application of cold or evaporating lotions, and should abscess result, it must be freely opened under aseptic precautions.

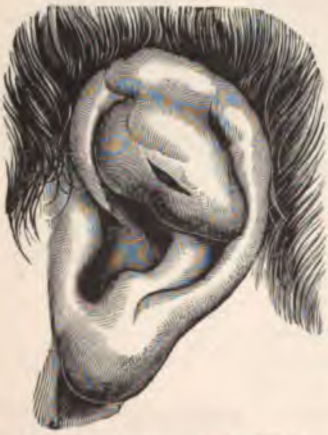

FIG. 96.—Hæmatoma auris (Follin).

FOREIGN BODIES IN THE MEATUS

Foreign bodies of the most diverse nature are not infrequently introduced into the meatus by children, and as they are usually much smaller than the canal, may remain undetected for a long time.

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[1] Only those diseases which are peculiar to the ear, and come under the notice of the general surgeon, are here described.

If the body is capable of absorbing moisture, it gradually swells, and hence attention is sooner drawn to its presence. Deafness and tinnitus are common symptoms; and if the foreign body is driven deep into the meatus so as to impinge against the membrane tympani, more serious results may follow. Impacted bodies may excite inflammation with suppuration, and unless they are quickly removed the membrane may become perforated, and disease of the middle ear result. In rare cases epileptiform convulsions, persistent sneezing, and other symptoms may be reflexly excited.

Treatment.—In all cases in which a foreign body is suspected, it must be clearly seen before any attempt is made to displace it. For this purpose a good light is essential, and if the patient is a child, or very nervous, he should be placed under an anæsthetic. Care must be taken that attempts to extract it do not drive the body deeper into the canal, or the membrane may be damaged. The isthmus is the narrowest part of the canal, and foreign bodies beyond this point are difficult of removal. In most cases the body may be dislodged by gentle syringing, the nozzle of the syringe being placed along the roof of the canal. If this fails at first, it may be repeated daily until success results, provided the symptoms do not call for urgent relief, in which case the body must be removed with a hook, a wire-snare, or a pair of aural forceps, while the patient is anæsthetised. In some cases a foreign body may be carefully removed piecemeal. When the body is firmly impacted against the membrane, and cannot be removed by other means, the auricle must be detached and turned forwards, so that free access is obtained.

Impacted cerumen may be due to chronic local irritation increasing the normal secretion, which may be naturally excessive, or it may be consequent on its retention in a very narrow canal. Deafness may be gradually induced, or may be quite sudden in its appearance, either owing to shifting of the mass of cerumen, so that it completely blocks the canal, or to its sudden swelling from the presence of water in the ear.

Buzzing in the ears, giddiness, and slight pain are sometimes present, and occasionally more grave symptoms are attributable to this cause.

In neglected cases the plug of cerumen, acting as a foreign body, may excite suppuration, or even lead to perforation of the membrane and tympanic mischief.

Treatment.—The day before the cerumen is to be removed the patient should drop a little warm oil or solution of bicarbonate of soda (gr. 15 ad ℥i.) into the meatus, in order to soften the mass traceable to local irritation, and seem to be very liable to occur in those who indulge in swimming, especially in salt water, which acts as an irritant. Gout and rheumatism are considered to be etiological factors. Osteomata grow slowly and painlessly; they may cause complete blocking of the canal, or prevent the due escape of cerumen. In rare cases they excite acute inflammation, with subsequent destruction of the membrana tympani. The symptoms are similar to those of accumulated cerumen, and these growths are often detected when, before examination, cerumen is credited with the symptoms produced. They are very hard when touched with the probe, and are usually pale on the surface.

Treatment.—The ear must be kept perfectly clean and free from cerumen. If the osteoma is small, no other treatment is necessary or advisable. When acute inflammation is excited, or if the tumour is large enough to block the canal, its removal becomes necessary. This may be effected when the tumour is pedunculated, by snaring it with a galvano-cautery wire; but when it is sessile and very dense, its size must be diminished by means of a drill or burr worked by an electro-motor or dental engine. The density is often very great, and every care must be taken that, during attempted removal, no damage is inflicted on the membrane.

THE MEMBRANA TYMPANI AND TYMPANIC CAVITY

INJURIES OF THE MEMBRANA TYMPANI

The membrane may be injured by instruments or pointed bodies thrust down the meatus, by an extension of a fissure in fracture of the base, or by caustics poured into the ear. Such injuries vary very much in extent. Injury by indirect violence is due to the sudden compression of the air in the meatus; it may occur from boxing the ear, or from loud explosions, especially if the mouth be closed at the time.

At the time of injury the patient may be conscious of a loud noise in the ear, accompanied by considerable pain. Bleeding is usually considerable, the blood escapes by the meatus, and sometimes down the Eustachian tube; the bleeding may continue for a few days, so that a view of the membrane cannot be obtained.

If the wound has been made by a dirty instrument, acute suppurative inflammation may result. The ultimate degree of deafness depends upon the severity of the violence which has been used, upon the size and nature of the perforation, and upon whether this heals soundly or not. If the force producing the injury has been great, as in loud explosions, the resulting deafness may be marked and permanent; Dalby attributes this to associated shock or damage to the labyrinth. Naval gunnery officers are very frequently deaf from this cause.

Treatment.—When the ear has been freed of blood clot, and carefully cleansed by gentle syringing with boric solution, it should be left alone, a pad of wool being placed over the auricle. If non-interference be observed, the perforation will usually heal soundly after a few days. If pain and inflammation result, a leech behind the ear, with hot fomentations over the auricle, should be employed. Suppuration must be treated as described at p. 279.

INFLAMMATION OF THE TYMPANIC CAVITY—OTITIS MEDIA

Causes.—In the great majority of cases inflammation of the tympanic cavity is due to the spread of mischief from the naso-pharynx. An ordinary cold in the head, chronic rhinitis, or pharyngitis lead to the least serious results. Adenoid vegetations, scarlet fever, measles, diphtheria, and influenza may excite an inflammation which, though perhaps trivial at first, may lead to suppuration and perforation of the membrane, with one or other of its more serious complications. Otitis media may also be consequent on syphilitic ulceration, or may be due to the invasion of the cavity by pyogenic organisms, or by the tubercle bacillus. The disease is chiefly met with in the young, since its causes are most likely to affect children. In some cases the inflammation may occur from injury of the tympanic membrane, or from pathological conditions of the meatus, which have not received prompt or efficient treatment; thus acute inflammation of the meatus, either occurring as a furunculosis or from the irritation and obstruction caused by an impacted foreign body, by cerumen, or by the presence of an exostosis, may lead to perforation of the membrane, and consecutive inflammation of the tympanum. The severity of the inflammation, its duration, and results depend in great measure upon its cause.

NON-PURULENT OR CATARRHAL INFLAMMATION

This form originates from adenoids, acute or chronic catarrh, and syphilis of the throat; the inflammation spreads to the ear by the Eustachian tube.

In the mildest form there is little or no exudation, but there may be a considerable quantity of a serous or mucous character. Successive attacks are not uncommon.

Symptoms.—In the mildest form, such as may accompany an ordinary cold in the head, the patient complains of slight deafness, a sense of fulness in the ears, with buzzing or some adventitious sound. There is little or no pain. The deafness is sometimes temporarily improved by swallowing, as the Eustachian tube is thus pulled open and fresh air enters the tympanic cavity. These signs may all subside within a week. In more severe cases the symptoms become more pronounced, and the patient may complain of earache, which is, however, rarely severe. Deafness may be almost complete, though liable to temporary improvement, if air passes through the Eustachian tube.

Examination with the speculum may show the membrane to be depressed or bulged, according to whether the air in the tympanic cavity is merely rarefied or the cavity is filled with fluid. In the latter case the bulged segment may present a yellowish or yellowish-grey tinge. Fluid in the cavity may also give moist râles when Politzer's inflation and the otoscope are used, in place of the dry sound when fluid is absent, or when it is inspissated.

If the tympanum is filled with fluid the membrane may become atrophied by pressure and bulge very distinctly at one point, and unless relief is afforded by an incision it may rupture. Suppurative inflammation may follow the non-suppurative form, especially if any cause persists in the naso-pharynx. Repeated attacks may lead to suppuration, or may cause thickening and opacity of the membrana tympani, which may become infiltrated with calcium phosphate.

The prognosis of non-purulent catarrh depends mainly upon the cause and the possibility of its removal. If the attacks are repeated, or the inflammation becomes chronic, the most that can be expected is partial recovery, but after acute attacks, such as may complicate an ordinary cold in the head, complete and rapid recovery is to be expected.

Treatment.—The essential part of the treatment consists in the removal of any local cause in the throat, *e.g.* adenoids. The disease itself should be treated by inflation of the tympanum by Politzer's bag, which will at once improve the hearing. The patient will experience a sudden "crack" in the ear (which the surgeon may also appreciate if he uses the otoscope), indicative of the success of inflation. The improvement may only last for an hour or so, in which case the treatment must be repeated daily; in other cases the hearing may remain good for a considerable time, and under such circumstances the inflation of the cavity need only be repeated every second, third, or fourth day, the interval being proportional to the results. As soon as the swelling of the mucous membrane of the Eustachian tube has subsided air readily enters the tympanum, inflation is then no longer necessary, and, if continued, does more harm than good. If there is evidence that there is fluid accumulation in the tympanic cavity, which, owing to its viscid character, cannot escape, it may be carefully washed out with a few drops of a solution of bicarbonate of soda (5 gr. ad ℥i.) through a Eustachian catheter; the soda solution tends to render the accumulation more liquid. If the membrane is bulged and is threatening to yield this should be incised, and the fluid driven out by the use of Politzer's bag. In chronic cases the injection of the vapour of muriate of ammonia is beneficial.

SUPPURATIVE INFLAMMATION OF THE MIDDLE EAR

Suppurative otitis media, the most common disease of the ear, is, owing to the disastrous consequences which it may entail, of the greatest importance. The disease usually occurs in children, and is commonly due to scarlet fever, measles, diphtheria, influenza, or the presence of adenoid vegetations, although it may follow any of the conditions mentioned on p. 276.

General course.—In some cases (especially if it complicates one of the acute exanthemata, the symptoms of which mask the local trouble), the disease is unnoticed during its early stages, a discharge from the ear being the first sign to attract attention. As a rule, however, there is an initial stage characterised by injection, redness, and swelling of the tympanic mucous membrane and membrana tympani. Suppuration rapidly occurs, and within a few days the inflamed and softened membrane becomes perforated, and the discharge escapes externally. Under appropriate treatment complete cure may result, and the perforation of the membrane heals without any permanent ill results following.

In many cases the disease unfortunately becomes chronic, and in such granulations may spring up, and, by blocking the outlet, cause temporary acute exacerbation of the mischief as a result of the retention of the pus. The disease may spread to the meatus externus, to the periosteum beneath the mucous membrane, and consequently excite caries or necrosis of the temporal bone, or it may gradually invade the mastoid cells, or spread to the lateral sinus, the basal dura mater, or cause abscess of the brain. In chronic cases the membrana tympani may be almost entirely destroyed, or the ossicles may necrose or become ankylosed, and adhesions may form within the tympanum. The disease may also spread to the labyrinth. General septic infection is not uncommon.

Symptoms of the acute stage.—The onset is sudden. The patient complains of earache, which gradually increases until it becomes very severe, and the pain radiates over the head. There is usually local tenderness in front of and behind the ear, and the cervical glands may be slightly swollen and tender. The patient complains of a sense of fulness in the ear, accompanied by distressing throbbing, tinnitus, and buzzing. The constitutional disturbance is usually severe, and the temperature may rise to 105° F. On examination the meatus may be found swollen and very tender; the membrane is injected and bulged outwards by the fluid which is imprisoned within the tympanum; the bulging may be general, or may only affect a part of the membrane; the bulged area is usually yellowish in colour.

Within a few hours, or at most four or five days, the membrane becomes perforated and the pus escapes; the relief is followed by marked diminution of the local and constitutional disturbance. The perforation may be small or large; it is usually situated in the posterior and lower segment. The pus which escapes is often bloody, and may be very offensive; it is sometimes thick and tenacious from admixture with mucus.

Symptoms of the chronic stage.—If the morbid process be arrested the membrane will heal soundly and complete recovery ensue, but so long as any secretion of pus continues this cannot occur, and the patient suffers from chronic otorrhœa, with some degree of deafness. The deafness does not depend upon the fact of perforation, for this by no means necessarily entails it, but it is due and proportional to concomitant changes affecting the ossicles, the tympanic cavity, and the labyrinth. Thus if the ossicles are destroyed, or are ankylosed and adhesions are present, deafness is sure to result. During chronic otorrhœa acute attacks similar to that just described may occur, owing to the growth of granulations blocking up the outlet and consequent retention of discharge. These are readily seen through the speculum, and on their removal the symptoms rapidly subside.

Treatment.—In the acute stage, before there is decided evidence of suppuration, hot poultices or fomentations applied to the ear and side of the head may give much relief; if the pain is very great, from one to three leeches should be applied in front of the tragus over the mastoid, or in both situations. Warm cocaine and morphia lotion may also be instilled into the meatus.

As soon as the membrane bulges, owing to the accumulation of matter within the tympanic cavity, this should be evacuated by an incision, about 2 cm. long, made through the membrane behind the handle of the malleus, or through any local bulged area. If the patient is young or very nervous, a general anæsthetic should be administered, otherwise a 10 per cent solution of cocaine is all that is necessary; the pain, although severe, is transient. After the incision has been made the pus will begin to escape, and this can be materially aided by inflation with Politzer's bag, or by making the patient close his mouth and hold his nose, and then try to forcibly expire through the nose (Valsalva's method). The ear must be gently syringed with warm water or boracic solution, and subsequently dried with antiseptic wool on an ear-probe. The syringing must be repeated as often as necessary to remove the discharge; at first it may be advisable every four or six hours, but later on once a day will suffice. If the ear is thoroughly cleansed, the mischief may rapidly subside and the membrane heal, but in many cases the chronic suppurating stage succeeds, and must receive prolonged treatment by syringing and the insufflation of finely powdered boracic acid after the ear has been dried. Care must be taken that the quantity of boracic acid used is very small, or it may accumulate in the ear and form a dense plug with the discharge. Iodoform is sometimes used instead of boracic acid, but is not so good. Should this fail to effect a cure, various astringent antiseptic lotions may be tried; of these the following will probably be found the most useful:—Peroxide of hydrogen, alum, gr. 5-15, or zinc sulphate, gr. 1-2, combined with a little rectified spirit (ʒi. ad ℥i.).

During the treatment the patient may wear a small pad of wool over the ear to prevent the access of cold air, which sometimes aggravates the condition. Wool should not be placed within the meatus, as it prevents the escape of discharge.

COMPLICATIONS OF MIDDLE-EAR DISEASE

It is the possibility of the occurrence of serious complications which makes any discharge from the ear a matter for grave anxiety and careful and prolonged treatment. These complications are as follows:—

Extension to the mastoid cells—Mastoid periostitis.—The involvement of the mastoid cells by direct extension, owing to continuity of the mucous membrane, will usually occur, but it by no means necessarily follows that such invasion will be accompanied by mastoid abscess and the train of symptoms associated with it. So long as any pus which forms can find a free exit from the mastoid into the tympanum, and thence externally, and so long as the process is not aggravated by some complication, by cold or by injudicious treatment, mastoid abscess may not occur; but if free escape of pus is hindered by the growth of granulations, or in any other way, then the most acute symptoms will ensue.

Acute mastoid suppuration may be associated with subperiosteal abscess, or the latter condition may exist alone. In either case the symptoms are very similar.

There is extreme tenderness behind the ear, aggravated by even gentle percussion over the mastoid, which makes the patient wince. Pain radiates over the side of the head. The skin behind and above the ear is swollen red and œdematous, and, especially if there be pus beneath the periosteum, the ear projects downwards and forwards in a very characteristic manner, best appreciated when the head is viewed from behind. Fluctuation may be clearly discernible when the periosteum is involved, or if the pus within the antrum has perforated the outer wall; before this happens there may be distinct bulging of the bone. The abscess usually bursts just behind the ear, sometimes into the meatus, or the pus may burrow beneath the deep fascia and extend down the neck; sometimes the abscess spreads towards the dura mater, and the pus is discharged beneath it, or thrombosis of the lateral sinus or cerebral abscess may complicate the case. On examining the ear a profuse and usually fœtid discharge will be found, or the tympanic cavity may be filled with granulations, which prevent the free escape of pus, and have probably by so doing determined the occurrence of mastoid abscess. The patient looks and is extremely ill, especially if his rest has been prevented by pain. The temperature may be raised to 105° F., or even higher, and the constitutional symptoms are correspondingly severe.

Diagnosis.—Very similar constitutional symptoms may be induced by the temporary retention of pus within the tympanum owing to the growth of granulations, or by masses of inspissated pus. The local signs may be due to an acute periostitis over the mastoid which, under treatment, may subside without suppuration.

Treatment.—When the ear has been carefully examined, all granulations should be removed by means of a small curette or sharp-spoon, and the fœtid pus cleared away by gentle syringing. If the signs of mastoid abscess are not quite evident, the case may be left for some hours to see if this treatment is productive of benefit, and should this prove to be the case no further interference is at present called for. Acute periostitis without suppuration is best treated by the application of leeches and hot fomentations. As soon as it is evident that there is pus beneath the periosteum, or that the mastoid cells are diseased, operative treatment must be at once undertaken.

Operation for subperiosteal abscess.—The ear is drawn well forward and an incision is made parallel with it and down to the bone; the pus is evacuated and the bone carefully examined to see if there is a small opening leading into the mastoid cells, for the pus may have originated there and been discharged beneath the periosteum. If the bone is found to be intact and there are no symptoms pointing to pus retention in the mastoid, this should not be perforated, but hot fomentations should be applied and the wound allowed to heal from the bottom. Associated necrosis is uncommon, but if present must be treated on ordinary principles.

Perforation of the mastoid.—The mastoid is fully exposed, and if an opening is present this should be enlarged by the gouge or chisel, so that the cavity may be freely opened up. If the bone is intact the antrum should be opened with a gouge, chisel, or burr at a spot half an inch behind and above the centre of the auditory meatus. Care should be taken not to go behind a line drawn vertically upwards from the tip of the mastoid process, for here lies the lateral sinus. The cavity must be carefully sharp-spooned and all diseased material and masses of inspissated pus removed. The opening is made freely into the tympanum, so that fluid can be readily syringed through the meatus. The wound should be plugged with gauze and allowed to heal from the bottom. For the first few days the dressing may require changing twice daily, but as healing and general improvement take place, the frequency of the dressings may be gradually diminished until they remain untouched two or three days, or even longer.

Chronic mastoiditis is a much less hopeful condition than is the acute form. The antrum and mastoid cells may be considerably enlarged by destruction of the walls, and the cavity is often filled with caseoüs masses of inspissated pus. Sometimes the cells are more or less completely obliterated by chronic osteitis, or caries and necrosis may complicate the condition. The treatment is conducted on the same lines as for acute suppuration.

Caries and necrosis of the temporal bone.—Chronic suppuration of the ear may, especially in children, lead to caries and necrosis of the ossicles or of some part of the temporal bone. The gravity of the bone disease is dependent on its seat rather than on its extent; thus quite a limited amount of disease of the tympanic roof or of the sigmoid sinus is likely to occasion the gravest intracranial complications. Fortunately the outer wall of the mastoid process is most usually affected, owing to the frequency of mastoid periostitis and suppuration within the antrum. Bone disease may exist for many years without leading to any grave consequences, although a patient with such a condition is always in great danger. The discharge from the ear is profuse, watery, often bloody, and very fœtid. Persistent granulations which repeatedly spring up after they have been removed are very suggestive of bone disease. If the pus has not a free exit there will be evidence of its being pent up within the antrum or external to it, beneath the skin of the meatus or within the tympanic cavity. The diseased bone may be felt by gentle probing through a speculum under a good light. The treatment must be conducted on ordinary principles, but caries of the bone close to the cranial cavity should not be scraped for fear of opening it. During any operation for the removal of sequestra the proximity of the facial nerve must be remembered.

Intracranial complications. — Chronic suppuration of the ear may lead to extra- or sub-dural abscess, to leptomeningitis, to cerebral or cerebellar abscess, or to infective thrombosis of the sigmoid sinus. These conditions are fully described in chap. ix. p. 223.

Facial paralysis.—Facial paralysis may be caused in cases of ear disease, by involvement of the nerve in the inflammatory process, by the pressure of exudation, and by caries or necrosis of the Fallopian canal. If the nerve is merely compressed, complete recovery may ensue when the inflammatory material has become absorbed, but if it has been destroyed by ulceration, the paralysis is necessarily permanent and the facial muscles undergo consecutive degeneration and atrophy.

"POLYPUS" IN THE EAR

Granulations.—The great majority of so-called aural polypi are masses of granulation tissue occurring in association with chronic otitis media. When they are associated with bone disease they may repeatedly recur in spite of all treatment. Granulations may merely give rise to some discharge (often bloody) from the ear, but if they are neglected they cause serious symptoms and lead to the graver results of chronic ear disease, owing to their blocking the exit and causing retention of pus within the tympanum; the pus is, moreover, almost certainly septic.

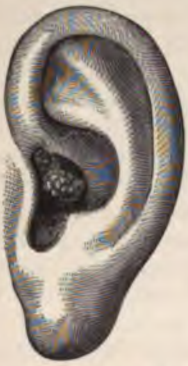

FIG. 97.—A polypus of the ear projecting from the meatus (Follin).

On examination the granulations will be plainly seen projecting through and completely filling a perforation in the membrane, or springing from some part of the external meatus.

Treatment.—The granulations should be very carefully removed under an anæsthetic by means of a fine sharp-spoon or curette. The bleeding is usually profuse. The bases of the granulations should be treated by cauterising with chromic acid applied every third or fourth day; in mild cases a 10 per cent solution answers very well, but when the granulations are extensive the solid acid fused on a warm probe is to be preferred; the ear must be dried after the application which causes some subsequent pain. Granulations may also be successfully destroyed by the instillation of about ten drops of rectified spirit and an equal quantity of warm water after the ear has been thoroughly cleansed and dried. The instillation should be repeated twice daily.

True polypi.—Mucous and fibrous polypi are sometimes met with in the ear, and are usually traceable to old tympanic disease. The mucous polypus is the most common variety; it is usually pedunculated, is soft and vascular, and is composed of delicate connective tissue infiltrated with round cells and enclosing small cystic spaces; the growth is covered with stratified epithelium continuous with that of the surrounding mucous membrane, which may be considerably thickened by chronic inflammation. Polypi grow slowly but may attain a size sufficient to block the meatus, or even project at the orifice (Fig. 97); under such circumstances severe symptoms may be induced by pent-up pus in the tympanic cavity. Polypus causes chronic suppuration, and the discharge is not infrequently mixed with blood. Examination of the ear will reveal the presence of the growth, which is soft and can be moved and indented by the probe.

Treatment.—Removal by the snare, ring-knife, or a pair of forceps must be followed by the application of chromic acid every third or fourth day, so that the base of the polypus may be completely destroyed. The otorrhœa will subside with the removal of its cause.

CHAPTER XII

DISEASES OF THE LARYNX—OPERATIONS ON THE THORACIC VISCERA

DISEASES OF THE LARYNX

ACUTE LARYNGITIS—ŒDEMA LARYNGIS

A MILD form of acute laryngitis may accompany an ordinary cold, and is very liable to do so in persons specially liable to catarrhal affections. Overstraining the voice, the inhalation of steam or irritating vapours, influenza, and sometimes the specific fevers, especially measles, may all occasion laryngitis in varying degrees of severity. Laryngeal catarrh, due to erythematous patches on the mucous membrane, is not uncommon in the early stages of secondary syphilis (see p. 185, vol. i.).

Morbid anatomy.—In the mildest cases the mucous membrane is congested and there is slight swelling of the submucous connective tissue. When laryngitis is due to some potent cause, such as the inhalation of steam, or the spread of erysipelas and the like, the swelling of the submucous tissue may be extreme and cause complete closure of the glottis (*œdema laryngis*). The œdema is chiefly present in the neighbourhood of the epiglottis and arytæno-epiglottidean folds, the submucous tissue being especially abundant in these situations; in some cases superficial erosion of the mucous membrane and suppuration of the submucous tissue may occur.

Symptoms.—During the early stages there is some hoarseness, with dryness and pain about the throat, and a slight but irritating cough; these may be the only symptoms present. In more severe laryngitis the symptoms become more grave, and very soon mucus and muco-purulent secretion, occasionally mixed with streaks of blood, makes its appearance. The temperature is raised but does not usually run high; the constitutional symptoms are proportionately mild. In cases of œdema the gradual increase in the swelling is marked by the advent of dyspnœa which may become very pronounced; there is also more or less dysphagia. In severe cases the œdema so obstructs the glottis that asphyxia becomes imminent and demands laryngotomy; the dyspnœa is liable to paroxysmal exacerbation. The breathing is noisy and stridulous, and the patient, gasping for breath, calls into action all the accessory muscles of respiration; he is anxious, restless, and terror-stricken, the face is bathed in sweat, the lips are livid, and unless speedy relief be afforded he dies asphyxiated. Laryngoscopic examination in cases of laryngitis shows the congested condition of the mucous membrane, the swelling of the submucous tissue, and the fact that the movements of the cords are sluggish and imperfect.

Treatment.—The patient must be confined to a warm room (65° F.) and should refrain from talking; much relief may be afforded by the inhalation of steam, about ʒi. of tincture of benzoin being added to the pint of water. Wine of antimony in five-minim doses repeated every four hours is often very beneficial. Chloride of ammonium by inhalation or in tabloids, an ice compress to the throat, and ice by the mouth are very soothing and tend to reduce the swelling. If the dyspnœa becomes troublesome, an emetic may be followed by much improvement, but should the breathing be dangerously hampered, laryngotomy or tracheotomy, according to the age of the patient, must be performed. Those who are naturally predisposed to catarrh and who repeatedly suffer from catarrhal laryngitis should avoid overstraining the voice, cold, and all causes likely to produce an attack; and if possible should spend the winter in a mild, warm, equable climate, such as that of Egypt.

MEMBRANOUS LARYNGITIS

In the great majority of cases membranous laryngitis is due to diphtheria, but it may occur in a severe form quite independently of that disease, and sometimes results from scalds of the throat. It is characterised by the formation of a thick, tough, adherent membrane which may extend to the trachea and primary divisious of the bronchi, and may also be present on the fauces, tonsils, and pharynx. Membranous laryngitis, on account of its specific nature and the mechanical impediment which the false membrane occasions, is an extremely serious condition, especially in children, in consequence of the relatively small size of the larynx. Moreover, the constitutional symptoms are usually high owing to the absorption of toxines from the infected surface.

Symptoms.—In the early stages the symptoms are practically those of acute laryngitis, but as the membrane accumulates, the increasing dyspnœa becomes an extremely grave element in the case. Examination of the throat will reveal the presence of the false membrane.

Treatment.—In diphtheritic cases the anti-toxine treatment must be carried out. The dose of anti-toxine varies according to the source from which it is obtained; that supplied by the British Institute of Preventive Medicine should be given in 15-20 cc. doses, which may be repeated in twelve to twenty-four hours until benefit results, as evidenced by a fall of temperature and local improvement. In all cases of membranous laryngitis, tracheotomy must be performed as soon as respiratory difficulty becomes marked.

CHRONIC LARYNGITIS

Chronic laryngitis is usually met with in those who habitually overstrain the voice, *e.g.* costermongers. It is undoubtedly aggravated by indulgence in alcohol. The condition may, like chronic rhinitis, with which it is often associated, assume a hypertrophic or atrophic form. In the former the mucous and submucous coats are thickened, and the glandular structures may be much enlarged; but in the atrophic form the lesion is characterised by thinning of the tissues.

Symptoms.—The patient complains of discomfort, and a constant tickling in the throat, which causes him to cough and hawk up mucus, especially in the morning. The voice is hoarse, gruff, and low, and there may be almost complete aphonia. Laryngoscopic examination shows that the mucous membrane is altered in thickness, and has a mottled greyish-white colour; the cords have lost their normal whiteness, and are more or less congested; their movements are frequently impaired.

Treatment.—Complete rest to the voice is essential. The larynx should be swabbed over once a day with a solution of zinc chloride or silver nitrate (grs. 10 to 30 ad ℥i.), and if this does not do good, the strength must be gradually increased; but the treatment must not be continued for more than two or three weeks at a time. Creasote, or chloride of ammonium by inhalation or spraying, may also be employed in conjunction with the painting, and in mild cases without it.

The digestion must be improved, the quantity of alcohol reduced, and the patient warned to avoid sudden changes of temperature.

TUBERCULAR LARYNGITIS

Primary tuberculosis of the larynx is very rare; but the disease not infrequently complicates pulmonary phthisis, usually at a late, but sometimes at an early stage of the affection.

Morbid anatomy.—The epiglottis, arytæno-epiglottidean folds, and neighbourhood of the arytenoid cartilages are the favourite seats of the disease. The mucous membrane is thickened, but not equally so throughout; in some cases the thickening is not seen, for if ulceration occurs early infiltration will be but slight. Sooner or later ulceration and erosion occur, in consequence of the breaking down of the tubercular foci; and by a gradual extension of the mischief and fusion of adjacent ulcers, the destruction may be very extensive. The epiglottis and arytænoid cartilages may be completely destroyed, and as the disease extends in depth, perichondritis and necrosis, with suppuration, may extend to the cricoid and thyroid cartilages. During the destructive process œdema laryngis may occur. The disease sometimes extends to the trachea.

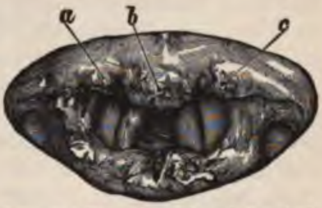

FIG. 98.—Extensive tuberculosis of the larynx. *a*, *b*, *c*, remains of the epiglottis (Tillmans, after Türett).

Signs and symptoms.—The symptoms are those of chronic laryngitis, with which will be associated evidence of pulmonary phthisis, and the presence of tubercle bacilli in the sputum. There is hoarseness, pain, and irritation about the throat, with considerable dysphagia, especially if the epiglottis is much diseased and the laryngeal cartilages are affected. Aphonia may be very marked. Laryngoscopic examination will reveal patches of pallor, a greyish or yellowish tint with areas of erosion of the mucous membrane, which is swollen and irregularly thickened, especially anteriorly, near the base of the epiglottis. There is impaired movement of the cords, and the epiglottis is turban-shaped. Sometimes definite small tumours, caused by the tubercular deposit, may be present. As the disease advances the difficulty in breathing may become very distressing, and necessitate the performance of tracheotomy. Under treatment considerable improvement may occur, and sometimes the small erosions cicatrise; but, more usually, the disease slowly progresses.

Treatment.—The open-air treatment recommended for pulmonary phthisis should be rigorously enforced, and if possible the patient should be sent to Egypt, the high Alps, Madeira, or the Canaries, according to the season, provided his general condition is not hopeless. The general treatment applicable to the tubercular diathesis must be carried out; creasote and guaiacol, administered internally, are highly spoken of.

Locally a spray of cocaine will be useful if there is much pain, and when ulceration has occurred, iodoform, combined with morphia or [illegible] should be insufflated once daily. A solution of lactic acid, varying in strength from 20 to 50 per cent (or even stronger as the patient becomes tolerant of the application), should be rubbed over the ulcerated surface to which cocaine has been previously applied; this must be repeated about every third day, and as healing begins to take place, at longer intervals. In some cases the tubercular masses may be curetted; but this is only of the various parts of the larynx, limits the movements of the cords, and, gradually contracting, may cause such a degree of stenosis that tracheotomy is necessitated.

Symptoms.—The signs of syphilitic laryngitis are those common to all forms of chronic laryngitis, coupled with distinct evidence of syphilis, and the absence of the tubercle bacillus from the sputum.

Treatment.—Gradually increasing doses of iodide of potassium must be persevered with until healing has occurred, and may, especially if mercurial treatment has not been carried out effectually during the second stage of the disease, be combined with a little of the perchloride. The resulting stenosis of the larynx may necessitate tracheotomy.

Local treatment is not usually required.

INNOCENT TUMOURS OF THE LARYNX

Papillomata form about 67 per cent of all morbid growths of the larynx, and are chiefly met with on the anterior part of the vocal cords (Fig. 99). These tumours resemble papillomata elsewhere, and are pedunculated or sessile; they may be so numerous, or, if single, so large, as to almost fill the larynx.

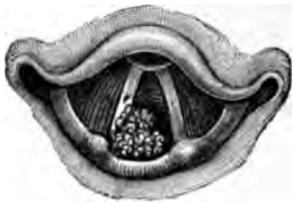
FIG. 99.—Papilloma of the right vocal cord (Tillmans).

Papillomata are very vascular, and unless the base be thoroughly removed tend to recur; they may become cancerous.

Fibromata of the larynx are rare, and usually grow anteriorly from, or near to, the true vocal cords. The tumour is always single, may be pedunculated or sessile, but, unlike the papilloma, is smooth on the surface, although it may be lobulated. These growths slowly increase in size, but sometimes remain quite stationary; they are composed of dense fibrous tissue with blood-vessels, are quite innocent, and do not tend to recur after removal.

Adenomata.—Gland-like tumours may arise in connection with the gland tissue met with in the mucous membrane of the larynx, and are consequently most commonly seen where this element is most abundant, viz. at the base of the epiglottis, in the arytæno-epiglottidean folds, and in the mucous membrane over the arytenoid cartilages; they consist of a fibrous tissue stroma, with enlarged follicular spaces. These tumours are sessile or pedunculated, and, when quite small, are of a deep red colour, but as they enlarge the tint becomes much paler.

Symptoms.—There is progressively increasing hoarseness and loss of voice, which may culminate in almost complete aphonia as the tumour enlarges. A slight hacking cough is sometimes complained of. Difficulty of breathing is proportional to the size of the tumour, and depends also upon its actual position. If the growth is pedunculated, the dyspnœa may be subject to paroxysmal exacerbations, and the other symptoms may similarly be worse at times. Laryngoscopic examination will reveal the seat and probable nature of the growth.

Treatment.—Innocent tumours of the larynx, after attaining a certain size, may not only cease to grow, but gradually atrophy and ultimately completely disappear. If such a happy event should seem to be in progress, the surgeon need not be in a hurry to attempt removal.

The ease with which a tumour can be removed depends upon its size, upon whether it be pedunculated or sessile, but chiefly upon its actual position. After the parts have been rendered anæsthetic by cocaine, the growth may be removed by laryngeal forceps or scissors; but if it is large, or if papillomata are numerous, or the growth is in such a position that this cannot be effected, thyrotomy will be necessary.

In the case of children, thyrotomy should always be performed.

CYSTS OF THE LARYNX

Cysts are rarely met with in the larynx. They may be due to distension of a follicle by retained secretion, to degenerative changes occurring in an innocent tumour, or to the presence of the hydatid.

Follicular cysts are the most common; they usually occur near the epiglottis, or in the ventricle, and rarely attain a size greater than that of a pea.

A cyst should be laid open by removal of part of the wall.

MALIGNANT DISEASE OF THE LARYNX

Squamous epithelioma is the usual form of malignant disease met with in the larynx, but glandular cancer or sarcoma is occasionally seen. Secondary invasion from the pharynx is not uncommon. Cancer is more common in males than females, in the proportion of about 4 to 1. The disease usually arises in connection with the vocal cords or ventricular bands, and may appear as a warty growth, which infiltrates and thickens the mucous membrane, and speedily breaks down and ulcerates. The ulcer is ragged and unhealthy, and repeated hæmorrhage may occur from its surface. By gradual invasion the disease spreads to the adjacent tissues, and subsequently involves the cervical glands.

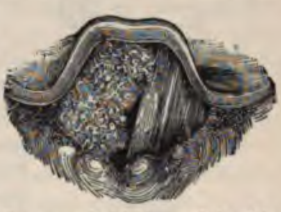

FIG. 100.—Epithelioma of the right vocal cord of one year's duration (Tillmans, after Ziemssen).

Symptoms.—The symptoms are at first similar to those occasioned by non-malignant new growths, or by tubercle or syphilis of the larynx; frequent bleeding, the involvement of the cervical glands, immobility of the cords, and the loss of health and strength are diagnostic features. The breath is fœtid, and there is usually considerable pain, which may extend along the superior laryngeal nerve to the auricular branch of the vagus. Laryngoscopic examination will reveal the presence of the ulcer, and if there be any doubt as to its nature, a portion of its margin must be removed and submitted to microscopic examination. The situation of the ulcer and its limitation are suggestive of its nature.

Treatment.—Complete removal by laryngectomy should be performed, provided the disease be strictly confined to the larynx, and has not invaded the tissues outside it, or the cervical glands. Failing this, the relief of pain and the performance of tracheotomy to avoid death by suffocation are the main indications.

FOREIGN BODIES IN THE LARYNX

A foreign body usually enters the larynx when the epiglottis is raised and the glottis widely open during a deep inspiration. Foreign bodies may also enter through a wound in the throat, or may pass into the larynx during vomiting. It is important to remember that a foreign body lodged in the œsophagus behind the cricoid cartilage may exert such pressure on the trachea as to cause dyspnœa and even asphyxia. The nature, size, and shape of the foreign body will materially influence the point at which it will become impacted, and the results which it may occasion. Foreign bodies capable of absorbing moisture are more harmful than those of equal size which cannot do so, since they tend to swell, and hence not only become more firmly fixed, but increase the obstruction. Sharp-pointed bodies, such as fish-bones, may pierce the mucous membrane and excite suppuration and ulceration.

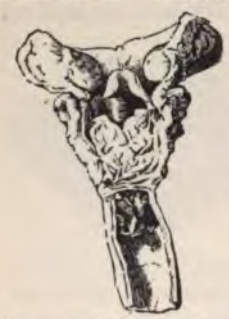

FIG. 101.—The larynx and part of the trachea of a child; the posterior wall of the latter has been removed. Impacted in the larynx is a toy made of a whistle (close beneath the epiglottis), and a bladder (in the trachea) (Westminster Hospital Museum, No. 760. Drawn by C. H. Freeman).

If a foreign body is small it may be immediately coughed up, or it may pass into the trachea and lodge in a bronchus, usually the right. If the body remains impacted in the larynx, it will sooner or later excite inflammation and suppuration, or it may at once set up severe œdema, which may prove fatal.

Symptoms. — The patient is seized with sudden and severe dyspnœa, which may prove immediately fatal unless assistance be at hand. Even if the body be not large enough to completely obstruct the larynx, it may do so by exciting spasm of the glottis.

In the case of a small body there may be practically no symptoms, and its presence is only revealed by laryngoscopic examination, but such an examination is not always possible, especially in the case of young patients. Even if no symptoms are present at first, the foreign body may suddenly shift its position during an attack of coughing, and sudden death from asphyxia may result.

Treatment.—If dyspnœa is urgent, immediate laryngotomy must be performed. In less urgent cases an attempt may be made to locate the body with the laryngoscope and remove it with laryngeal forceps after the parts have been rendered tolerant by cocaine. If all attempts at removal fail, laryngotomy must be performed, and an attempt made to remove the body at once or after a few days when the patient has grown accustomed to the tube. In rare cases thyrotomy will be necessary.

FOREIGN BODIES IN THE TRACHEA OR A BRONCHUS

If a foreign body passes beyond the larynx it rarely impacts in the trachea, but may remain movable in it; in most cases, however, it passes to the right bronchus. When a foreign body has passed to the bronchus, it will cause pain behind the manubrium, usually rather to the right of the middle line, with some cough and perhaps bloody expectoration. On examination of the chest it will be evident that the lung on the affected side is not being fully distended with air, and consequently the patient suffers from shortness of breath, and the respirations are rather hurried; partial or complete collapse of the lung may follow. It sometimes happens that during a violent fit of coughing the foreign body is dislodged, and carried up to the larynx, in which it may become impacted and cause death by suffocation. A foreign body lodged in a bronchus eventually causes bronchiectasis and abscess, and in some cases has been cast out through a sinus opening on the chest wall.

Treatment.—Tracheotomy must be performed as low down as possible; a piece of silk is passed through each side of the opening in the trachea, so that this can be held wide open, and thus a good view obtained. If the mucous membrane is now irritated, or a feather is passed down the tube, a fit of coughing will be excited, during which the foreign body may be driven up to the opening and may be seized by forceps and extracted; but to do this the surgeon must be quick, for the body will be drawn down again by the succeeding deep inspiration. If removal cannot be effected at the time, the patient must be put to bed and carefully watched by a skilled assistant, who will take advantage of any appearance of the body to remove it.

If the body remains fixed in spite of all coughing, an attempt must be made to remove it by means of tracheal forceps or a piece of bent wire, after its situation has been determined by probing.

OPERATIONS ON THE LARYNX AND TRACHEA

INTUBATION OF THE LARYNX

Intubation of the larynx is sometimes employed in cases of acute and temporary closure, such as may occur in membranous laryngitis, in place of laryngotomy or tracheotomy. The procedure is not easy, especially in the case of young children who will not keep still, nor is it by any means free from danger. The largest tube which the larynx will allow to pass must be introduced, but without the slightest force, or considerable damage may be inflicted on the cords. The tube may be left untouched for three or four days, when it should be removed and cleaned, and may be left out altogether if the breathing is easy. It must be remembered that unless great care be taken, the food may pass along the tube into the larynx.

The difficulties and dangers attending intubation are such that most surgeons prefer tracheotomy. The tube may invaginate false membrane, or may become occluded by it and mucus which cannot be coughed up; either of these conditions will demand immediate tracheotomy. Even if the tube be introduced it may be coughed up again; and in any case the clearance of the trachea cannot be effected so completely as after tracheotomy.

LARYNGOTOMY AND TRACHEOTOMY

These operations may be required for any of the following conditions:—For obstruction to respiration due to œdema laryngis, membranous laryngitis, chronic, syphilitic, or tubercular laryngitis with cicatrisation, spasm due to aortic aneurism or pressure from without, foreign bodies within the air-passages or in the œsophagus causing pressure on the trachea; in cases of malignant disease, or large innocent growths of the larynx impeding respiration and exciting spasm, and lastly, as a preliminary measure in operations about the larynx, tongue, jaws, and floor of the mouth.

Choice of operation.—Laryngotomy should be chosen when relief must be given at once, since it can be so speedily performed: it is also indicated as a preliminary to other operations except those on the larynx itself.

Laryngotomy should not be performed before the age of puberty, because it involves the crico-thyroid membrane, and may interfere with the development of the larynx; the only exception to this rule is in cases of imminent danger of asphyxia, where a minute or two may decide between life or death, in such all considerations except the preservation of life must be set aside.

Tracheotomy above the isthmus is the operation usually selected, but the trachea must be opened low down (1) before laryngectomy; (2) for malignant disease of the larynx; (3) for foreign bodies in a bronchus. The low operation is the more difficult, owing to the greater depth of the trachea; it is also more dangerous because of the presence of large veins, and the proximity of the mediastinum to which inflammation and suppuration may extend should these conditions affect the cervical wound. In the low operation a long tube will be necessary.

High operation.—In urgent cases an anæsthetic must be dispensed with, but if time allows a little chloroform should be given, not only to quiet the patient, but to allay spasm of the glottis. Ether should not be employed. The patient is placed on his back, with the head thrown back, a sand-bag being placed under the nape of the neck so as to render the trachea prominent.

The assistant holding the hooks stands above the head, and it is his duty to keep the chin in a line with the suprasternal notch, and to steady the head by placing his wrists against the malar bones. A second assistant stands on the left side and takes charge of the sponges.

The surgeon places his index finger at the suprasternal notch, and then runs it up in the middle line until he feels a distinct prominence—the cricoid cartilage. From the upper border of this he commences an incision which must be about one and a half to two inches long and must be made strictly in the middle line. The superficial structures are divided, and if any cross branches of vein are exposed they must be clamped and divided. The interval between the sterno-hyoid muscles is defined and they are hooked outwards. The isthmus of the thyroid gland and the cricoid cartilage now come into view. The deep cervical fascia is incised transversely, where it is attached to the upper border of the cricoid, and the handle of the knife is then passed beneath it, and it is forcibly pushed downwards towards the sternal notch. By this manœuvre the rings of the trachea are at once exposed and the thyroid isthmus and inferior thyroid plexus of veins are avoided. A sharp hook is introduced between the second and third or third and fourth rings of the trachea to the right of the middle line and the tube is drawn well forward. As this is done the patient will cough. The knife, held about half an inch from its point and with the cutting edge turned towards the cricoid, is thrust into the tube in the middle line and the rings of the trachea are divided. The hook is still kept in position, and a little lateral traction being put upon it, the opening in the trachea is enlarged, so that the tube can be readily introduced; some surgeons prefer to use a trachea dilator for this purpose.

Choice of a tube.—Parker's is certainly the best (Fig. 102); it has the great advantage of being adapted to the shape of the wound and the trachea which it must traverse, and hence the end of it does not impinge against the posterior wall of the latter, and the danger of ulceration is avoided. If a tube has to be worn for any length of

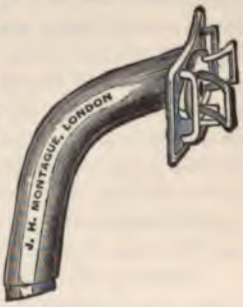

FIG. 102.
Parker's tracheotomy tube.

time, one of india-rubber or vulcanite, preferably the former, should be employed.

Difficulties and dangers—The middle line.—Unless the operation be strictly confined to the middle line of the neck, the trachea may be missed. A like accident may occur if the tube has been displaced by a tumour growing in the neck. In such a case the situation of the trachea must be carefully ascertained, and the operation must be modified according to its position.

Hæmorrhage.—If the middle line be kept to there will be but little bleeding; but this may be profuse if the communicating branches between the anterior jugular veins are damaged, or if the thyroid isthmus or inferior thyroid veins are cut. If the bleeding is profuse, the trachea must not be opened until it has been arrested by ligature or pressure, according to the time at the surgeon's disposal, for if the trachea is opened while bleeding is still going on the blood will be drawn into it, and thus asphyxia may result.

Introduction of the tube.—The tube may be pushed outside the trachea, or between the mucous membrane and its wall, or between false membrane and mucous membrane; or if a collapsable tube be used, one flange may enter the trachea, the other passing outside it. Under any of these circumstances the breathing will be still further by folding it under the tapes. The room should be kept at an equable temperature of about 62° F.; but there is no need to moisten the air with steam, as some recommend. The tube and trachea must be kept free of mucus or membrane by gentle mopping with a clean feather (turkey's or guinea-fowl's are the best), or camel's-hair brush; but this should not be done more than is necessary, as it causes considerable irritation. The inner tube will also require to be removed and cleaned, but the outer one may remain untouched for two or three days. The tube should be dispensed with as soon as possible.

It is often difficult to feed young children after tracheotomy; but, by a little persuasion, they may be fed by means of an india-rubber tube passed to the back of the throat.

Laryngotomy.—The patient is placed in the same position as for tracheotomy, and an incision about one and a half inch long is made in the middle line, its centre being over the crico-thyroid membrane. The skin and superficial structures are divided and hooked aside, and the sterno-hyoid muscles are then separated; on drawing these aside the crico-thyroid membrane will be exposed, and on each side the fibres of the crico-thyroid muscle will be recognised running upwards and outwards. The membrane is divided transversely, midway between the adjacent borders of the thyroid and cricoid cartilages, so as to avoid wounding the branches of the crico-thyroid artery. The tube, which is flattened from before backwards, is readily introduced and tied in.

In cases in which death is imminent from the presence of a foreign body in the larynx, laryngotomy may be almost instantaneously performed in the following way:—The surgeon, seizing the larynx between the fingers and thumb, makes it project well beneath the skin, and thrusts a pen-knife transversely through all the structures and the crico-thyroid membrane; the aperture thus made can be easily held open by bent hair-pins or the like, and a quill toothpick will do temporary duty as a tube. There is little or no bleeding to be feared.

The after-treatment is the same as after tracheotomy.

THYROTOMY

Innocent tumour of the larynx and foreign bodies within it, which cannot be otherwise dealt with, must be removed by thyrotomy.

Tracheotomy above the isthmus is performed, and Trendelenberg's or Hahn's canula is used to prevent blood passing down the trachea. A median incision is made over the thyroid and cricoid cartilages, and the former is divided in the middle line by a sharp knife, or, if the cartilage is ossified, by a fine saw. Unless the middle line be kept to, the vocal cords will be damaged. The halves of the thyroid are now separated, and held aside by blunt hooks while the object of the operation is accomplished. Papillomata should be snipped away with scissors, and the bases touched with lactic acid solution (30 per cent) or some astringent. If the mucous membrane is first painted with cocaine, the hæmorrhage will be considerably diminished. The cartilage is now accurately united by kangaroo tendon run through part only of its thickness above and below. The tracheal tube must be left in until such time as the larynx is quite free; it may be for weeks or months.

Some impairment of the voice is very common owing to cicatrices hampering the proper action of the vocal cords.

EXCISION OF THE LARYNX—LARYNGECTOMY

Partial or complete removal of the larynx may be practised in cases of malignant disease limited to its interior; but if the disease has spread to the structures outside the larynx, if the glands are involved, or if the patient is in very enfeebled health, the operation, the mortality of which is high, is contra-indicated.

About a week previously a low tracheotomy should be performed, so that the patient may become used to the presence of the tube; moreover, the trachea unites to the wound, and thus remains *in situ*, instead of slipping down when it is cut across during laryngectomy. At the time of the operation thyrotomy should be first performed, as described above, so that the surgeon may at once ascertain the extent of the disease, and determine as to whether he will simply remove the soft structures and leave the cartilages alone, or whether he will perform partial or complete laryngectomy. If he intends to remove the larynx, a median incision is made from the hyoid to just below the cricoid, and at the upper end of this a transverse one extends between the anterior borders of the sterno-mastoid muscles.

The soft parts are now stripped from the front and sides of the cartilage with a raspatory, and the superior and inferior laryngeal vessels are secured and divided. The trachea having been cut across just below the cricoid, the lower end is at once drawn forward, and united to the skin wound by a few points of suture. The larynx is then dissected free from below up, the constrictors are divided with scissors close to the cartilage, and great care must be taken not to wound the œsophagus. The transverse cut is sutured, but the longitudinal one is left open and lightly packed with gauze, which will require replacing each day.

In the after-treatment great care must be taken to prevent food, mucus, or purulent fluid from entering the end of the trachea, or septic bronchitis or pneumonia may result. Rigid cleanliness is also essential, not only to prevent these complications, but to guard against cellulitis of the neck, which may spread to the mediastinum.

Ultimately an artificial larynx may be substituted, but the date at which this will be tolerated must depend upon the condition of the wound.

OPERATIONS ON THE THORACIC VISCERA

SURGICAL TREATMENT OF FLUID IN THE PLEURAL SAC[1]

Simple pleural effusion, when sufficient in amount to seriously embarrass the lung and showing no signs of absorption, must be withdrawn by aspiration or by the trocar and syphon. Blood in the sac may likewise require removal. Traumatic pneumothorax may also be tapped and the air drawn off.

Removal of fluid from the chest should be performed without anæsthesia if the patient is not very nervous, and in all cases if he is very bad, and the heart's action is much impeded. Chloroform is usually the best anæsthetic, as it causes but little pulmonary irritation. The usual seat of puncture is the sixth space in the mid-axillary line, the needle being thrust in at right angles, close to the margin of the seventh rib, so that the vessels which lie at the upper part of the space are avoided. Puncture below the ninth rib is not usually permissible, as the needle may wound the diaphragm, liver, or spleen.

Great care must be taken that the needle is absolutely clean, otherwise pyogenic organisms may be introduced and empyema result. If a trocar is used it should be connected with a piece of tubing, the other end of which is placed under carbolic acid, and the fluid is thus syphoned off. This method is preferable to aspiration, as the fluid is more gradually withdrawn and the thoracic viscera and circulation have time to adapt themselves to its removal.

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[1] For the physical signs of these conditions the reader is referred to works on Medicine.

In aspirating it is well not to have a complete vacuum, so that the withdrawal may not be too sudden. The withdrawal of fluid should be stopped if the patient shows signs of fainting, if the fluid becomes bloody, or if the patient is seized with coughing.

The small puncture must be closed with salicylic wool and collodion.

Empyema must be treated by removal of a piece of rib and free drainage. If there is any doubt as to the nature of the fluid, a little should be withdrawn by an exploring syringe. Chloroform is the best anæsthetic, but in very bad cases an anæsthetic had better not be given; or else some of the pus may be first withdrawn by aspiration, and then, if the patient's condition improves, the anæsthetic may be very carefully administered. Simple incision of an empyema in an intercostal space is now abandoned by nearly all surgeons in favour of removal of a piece of rib, which not only gives ample room for the drainage tube, but allows easy escape of the large masses of fibrin so often present; and which, moreover, enables the surgeon to introduce his finger with the view of determining the extent of the cavity and the necessity for counter-openings, and also of examining the state of the lung and ascertaining its power of expansion on removal of the fluid. Which rib is to be the seat of operation must depend on the situation of the fluid; but in complete empyema the ninth rib, just external to the angle of the scapula, is the seat of election.

Operation.—The patient should be drawn well up to the edge of the table, but not rolled too far over on the sound side for fear of still further embarrassing respiration. An incision about three inches long is made external to the scapular angle on the centre of the rib down to the periosteum, which is divided. Bleeding having been arrested, the periosteum is stripped off the lower half of the rib on its outer aspect and then along the lower margin, care being taken not to wound the intercostal vessels; the upper half and margin are similarly treated, and the rib is then denuded on its deep aspect, beginning at the lower border. A thin, slightly curved periosteal elevator answers the purpose well. The rib is now divided with curved bone-forceps at the anterior angle of the wound, then at the posterior, and removed. It is advisable to stop the anæsthetic at this stage before opening the pleura. This is done with a narrow knife; a finger is at once thrust through the opening and the cavity explored, the pus being allowed to escape gradually so that pressure is not too suddenly relieved, otherwise syncope may ensue. A large flanged tube is introduced just within the pleural sac, and an antiseptic dressing applied. The pus is often very fœtid, but the cavity should not be at once washed out, as fatal results have been sometimes induced by this means. As a rule the pus becomes sweet in a few days; should this not occur, gentle irrigation with weak iodine and water may be daily practised so long as any fœtor remains. Occasionally there is profuse bleeding from granulations, and this naturally increases the shock and danger to the patient; in such a case careful irrigation of the cavity with hot water may be tried.

The dressings must be changed as often as may be rendered necessary by the amount of discharge, and the tube should be kept in until this has practically ceased.

In recent cases the lung expands at once and healing is rapid. Empyemata in children are often soundly healed in three weeks or so. Double empyemata should not be operated on simultaneously.

Thoracoplasty or Estlander's operation may be required in the case of adults with much rigidity of the chest wall and a persistently discharging empyema, in which all progress towards cure is arrested. In such cases the natural rigidity of the chest wall is increased by great thickening and density of the pleura; moreover, the lung is frequently more or less collapsed, and hence the cavity is incapable of healing. The object of the operation is to remove the ribs, periosteum, and thickened pleura, and so allow the chest wall to fall in and close the cavity, and thus to rid the patient of a constant drain on the system, and the possible consequences of prolonged suppuration.

Operation.—The patient is anæsthetised and rolled on to the healthy side. The length of the pieces of rib to be removed must be determined by the antero-posterior diameter of the cavity, and the individual ribs and their number by its vertical extent; both of which are ascertained by the finger or probe. The site of the operation being thus decided, the ribs may be exposed by raising one large flap of integument and muscle, or by two or more incisions running between adjacent ribs. All bleeding should be arrested and the ribs isolated and cut away. The periosteum and pleura are then removed with strong scissors; the cavity is cleaned with iodine solution and the flaps sutured, except posteriorly, where a drainage tube is inserted and retained until the discharge has practically ceased. On raising the flap the hæmorrhage is smart, but in the subsequent stages of the operation it is slight, the intercostal vessels being usually obliterated. As healing occurs, the chest wall sinks in and a certain degree of lateral spinal curvature results.

It must be remembered that this operation is a serious procedure, and should not be undertaken if the patient is very feeble, or if there is mortal disease in the lungs or other viscera.

SURGICAL TREATMENT OF PULMONARY CAVITIES AND HYDATIDS

Phthisical cavities are not usually amenable to surgical treatment, although many attempts have been made to treat them by incision and drainage, and in selected cases apparent good has resulted.

Bronchiectatic cavities are usually multiple and often bilateral; when they are so, surgery offers but little prospect of alleviation. If it seems probable that there is one main cavity, and especially if the condition is supposed to be due to a foreign body in one of the bronchi, operation is indicated and should be undertaken if the patient's condition permits.

Gangrenous abscesses and cavities should always be opened when every care has been taken to strictly localise the seat of the mischief. Such abscesses are usually due to acute pneumonia, and are situated in the base of the lung. They burst into the bronchi and are partly emptied by expectoration, but the opening is usually too small to allow of complete evacuation; hence healing is impossible, and the patient's life is seriously imperilled. It must not be forgotten that in addition to the gravity of local suppuration in the lungs or pleural sac, the patient is exposed to the risk of general pyæmic infection, and that cerebral abscess is an occasional association.

Operation.—Before any incision is made into the lung the locality of the abscess should be ascertained by puncture with a sharp trocar, pushed, if need be, in various directions. When pus is tapped, an incision is made by the side of the trocar and enlarged with forceps; some recommend that the opening should be made with the actual cautery. A full-sized drainage tube should be inserted; it should reach the full length of the cavity and be left in until suppuration ceases. As a rule it will be found that the pleural sac is obliterated, and hence the operation is less dangerous, as no secondary empyema can result. Should this not be the case, it may be advisable to attempt to suture the lung to the costal pleura and postpone the second stage of the operation for a few days; but this is difficult, and the stitches often tear through.

A suspected foreign body should be sought for by probing, but is very frequently missed, even although it may lie close at hand.

Hydatids of the lung or pleura must be treated like pulmonary abscess or empyema.

SURGICAL TREATMENT OF FLUID IN THE PERICARDIUM[1]

Simple pericardial effusion is sometimes so large in amount that it becomes a serious matter by embarrassing the heart's action. Under these circumstances it must be withdrawn by aspiration.

Hæmatopericardium as the result of injury may demand similar treatment for the same reason, but the blood should not be withdrawn unless its removal is imperative, since the consequent removal of pressure may occasion fresh bleeding from the wounded vessel.

If there is reason to believe that the fluid in the pericardium is purulent, the diagnosis should be confirmed by the exploring needle, and on pus being found free incision must be practised as in the case of other abscesses.

Aspiration is performed with a very fine needle in the fifth interspace, about two inches from the edge of the sternum, so that there may be no fear of wounding the internal mammary artery. The needle should be held about one and a half inch from the point and thrust in at right angles, and then gently pushed on if necessary, every care being taken that the heart is not damaged.

Incision and drainage for pyopericardium is usually performed in the fifth interspace, the incision being begun about an inch from the sternal edge. A piece of the fifth rib cartilage may be removed if more room is necessary, but this should if possible be avoided. If the pleura is wounded, as it very likely will be, the pericardium when opened should be stitched to the parietal layer, so that no pus can find its way into the pleural cavity. A short drainage tube must be inserted and left in until the discharge has practically ceased.

CARIES AND NECROSIS OF THE STERNUM AND RIBS

Caries and necrosis may complicate empyema, but more usually result from subperiosteal tubercle or gummata. Chronic suppuration is induced, and unless the pus be evacuated sinuses form. In the case of the ribs a considerable abscess sac may form on the pleural aspect, thus simulating local empyema.

Treatment.—The abscesses should be freely opened and all diseased tissues removed by sharp-spooning. In bad cases complete removal of the rib is the best treatment. If the disease is syphilitic, iodides must be given. The course of caries of the ribs or cartilages is often very chronic.

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[1] For the physical signs of these states the reader is referred to works on Medicine.

TUMOURS OF THE CHEST WALL

New growths springing from the ribs are rare. Occasionally enchondromata attain a large size; they are usually mixed with sarcomatous elements and show evidence of malignancy. Free removal is the only treatment.

CHAPTER XIII

DISEASES OF THE THYROID GLAND

Anatomy.—The thyroid gland consists of two lobes, each about two inches in length, united by a narrow isthmus which lies in contact with the second, third, and fourth rings of the trachea, but may extend higher up. The lobes extend upwards and lie against the lower half of the thyroid cartilage; the left lobe is often in contact with the œsophagus. The sterno-thyroid, sterno-hyoid, and omo-hyoid muscles with a layer of deep cervical fascia are in front. Sometimes a small middle lobe extends upwards from the isthmus towards the hyoid bone and accessory thyroids may be met with. The thyro-glossal duct is referred to at p. 333.

The lobes of the thyroid lie in front of the carotid sheath.

The arteries of the gland are two superior and two inferior, the latter entering it on the deep surface and lying in close relation with the recurrent laryngeal nerves; the veins are superior, middle, and inferior. Occasionally a thyroidea ima artery is present.

The gland consists of numerous vesicles of small size lined by a single layer of cubical or columnar epithelium, and containing viscid colloid material. The interstitial connective tissue may also be infiltrated with the same substance.

ATROPHY OF THE THYROID—MYXŒDEMA—CACHEXIA STRUMIPRIVA—CRETINISM

From unexplained causes the thyroid gland tissue may undergo atrophy or may be congenitally deficient; in rare cases the gland is enlarged by fibroid tissue, but its secreting substance is diminished.

Destruction of the glandular substance leads to a chain of the most striking events. Myxœdema and cretinism are to be regarded as the same disease, the former occurring in adults, the latter as a congenital affection of children. Cachexia strumipriva is practically identical with myxœdema, but is dependent not upon a pathological condition of the gland but upon its complete removal by operation.

Myxœdema is fairly common in Europe, more so in some parts than in others, and is very rare in the Tropics. Although it may occur at any age, it is more usual between thirty-five and fifty, and is about seven times more frequent in females than males.

The disease is characterised by slowness of onset and gradual progress. Its leading signs are solid œdema of the connective tissue, muscular and mental lethargy, low temperature and anæmia. The patient increases in weight, and the facial expression is so altered that she becomes almost unrecognisable; the hands are broad and spade-like; the lips thick, and the skin is dry and harsh. The speech is slow, deliberate, and thick; muscular movements are feeble and slow, and the gait is peculiar, heavy, and hippopotamus-like (Bramwell). Mental activity is markedly diminished, and dementia may supervene.

Treatment.—The cure of this disease by the administration of the thyroid gland of a sheep is most remarkable. The action of the drug must be carefully watched as it affects the heart, sometimes to a dangerous extent. The raw gland, a glycerine extract of it, or thyroidin in powder, tabloids, or pills may be employed; the dose must be small at first, but may be gradually increased as tolerance is established. The treatment will usually effect a cure within three months, and the patient may be kept in good health by occasional doses, but if these be omitted a relapse will probably occur.

Cretinism requires the same treatment, but it must be conducted over a much longer period, and the results are less satisfactory.

THYROIDITIS—ACUTE GOÎTRE

This is a rare affection, and is more likely to affect a goîtrous than a healthy gland. It may occur at puberty or during pregnancy, or may be due to cold or to infection through a wound or by the blood stream, as in some acute infective diseases. Suppuration is rare. The whole or part of the gland rapidly swells, and, owing to the resistance of the deep cervical fascia, may lead to serious compression of the trachea and œsophagus. The neck is tumid and the veins are engorged. There may be some fever, with constitutional disturbance, which is more severe if suppuration should occur. Subsidence of the swelling will usually occur in two or three weeks.

Treatment.—The application of ice must be continuous. If the inflammation is very acute, with much fever, leeches may do good. When pressure symptoms are sufficiently severe to warrant it, the gland may be cut down upon and the cervical fascia divided in order to allow it to bulge forwards; in addition, the isthmus may be divided or removed. If suppuration occurs, the abscess must be opened.

GOÎTRE OR BRONCHOCELE

Etiology.—Goître is indigenous in certain mountainous regions, but in these its frequency varies in different districts; it may, however, occur sporadically. The actual cause of the disease is not known; it is variously attributed to an excess of lime and magnesia salts in the water, short hours of sunshine in valleys, carrying weights upon the head, etc., but the importance of these causes is very much open to question. Quite recently Grasset, as the result of ten years' observations of cases in the Puy-de-Dôme, has come to the conclusion that goître is the local expression of a general condition, and is analogous with the enlargement of the spleen in cases of malaria. He describes a hæmatozöon which he has met with in the blood of recent cases; this is spherical in outline and armed with a flagellum, it has no nucleus, but contains red pigment. He also found segmented bodies and a pigmented body of irregular contour. Grasset considers that the disease is infectious.

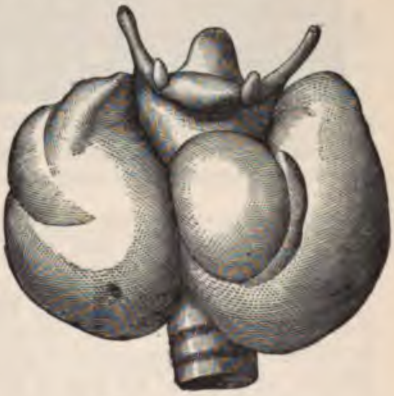
FIG. 103.—Goître (Follin)

The enlargement occurs more commonly in women than men, but in some parts, *e.g.* India, the disproportion between the sexes is very slight. Goître usually makes its appearance about puberty, and may continue to slowly increase in size, or, after a time, remain stationary.

Morbid anatomy.—Part or all of the gland may be enlarged; sometimes only one lobe is affected, or accessory thyroids may alone enlarge. In the early stages it seems probable that all the component structures of the thyroid are equally overgrown and may remain so throughout (*simple goître*), but not infrequently one or other of the elements increases in size beyond the others, and thus the *cystic, fibrous, or pulsating goître* is developed. Isolated goîtrous masses in the substance of the gland are sometimes known as adenomata.

The cystic goître is characterised by enlargement of the vesicles of the gland; by coalescence these may give rise to cysts of considerable size, which are often traversed by fibrous bands. The cysts contain a colloid material which may be blood-stained.

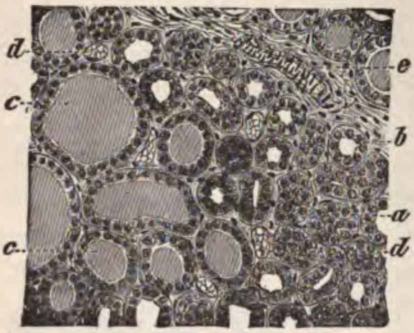

FIG. 104.—Section of a fibro-cystic goître (Ziegler). *a* follicles filled with cells; *b*, empty follicle; *c*, colloid material in dilated follicle; *d*, capillaries; *e*, stroma with an artery.

Fibrous goître consists in an overgrowth of the connective tissue, which causes pressure atrophy of the vesicular structure; the gland is enlarged, indurated, and dense.

If the vessels are much enlarged and dilated, the pulsating goître is developed; the veins are more enlarged than are the arteries. This form is especially met with in exophthalmic goître (Graves's disease).

Signs of enlargement of the thyroid gland.—The tumour may or may not retain the normal outline of the gland according to whether the enlargement is general or local. The size attained may be very great, so that a large pendulous mass hangs down over the sternum; more usually it causes a definite enlargement in the cervical region. The mass moves upwards when the patient swallows; the skin over it is normal in appearance, but enlarged veins may be very prominent beneath it. The carotid arteries are pushed aside and occupy a lateral position. In the cystic form definite fluctuation can be made out over the cysts, and these sometimes suddenly increase in size owing to hæmorrhage. Pressure symptoms are not usual, but there may be distinct evidence of tracheal or œsophageal obstruction, and sometimes aphonia from implication of the recurrent laryngeal nerves. Spasmodic dyspnœa is a dangerous symptom.

Treatment.—In recent cases removal from the goîtrous district is to be recommended, and is sometimes followed by complete recovery; the general health must receive attention. If the goître is not causing inconvenience, and is only of moderate size, there is no actual necessity for active treatment. Iodide of potassium in gradually increasing doses sometimes causes atrophy of a fibrous goître. The daily application of biniodide of mercury ointment, which is gently rubbed in over the gland, followed by long exposure of the neck to the sun's rays (or failing this to the heat of a fire), is extensively employed in India, and sometimes does much good. The injection of tincture iodine into the substance of the gland is not to be recommended on account of its danger. Iodo-thyroidin is said to be beneficial.

In cystic cases the cysts may be incised and allowed to granulate from the bottom, but if practicable they should be enucleated. The old plan of injecting cysts with iodine or iron solution is not to be recommended.

Removal of the entire gland should not be practised as myxœdema follows the operation, but if the enlargement is limited to one lobe it may be removed if necessary. Division or removal of the isthmus of the thyroid is followed by partial atrophy of the growth, and may be practised with safety. If serious pressure symptoms are occasioned, some such operative procedures become imperative.

Exophthalmic goître has been benefited by removal or division of the isthmus. Recently cases have been recorded in which the disease is said to have been much improved by removal or division of the sympathetic cervical chain on each side; if the latter is practised the nerve should be divided above the superior cervical ganglion. The sympathetic is reached through an incision along the posterior edge of the sterno-mastoid, which with the deep vessels of the neck is turned forwards. In some of the cases the exophthalmos and tachycardia have rapidly improved and the goître has become smaller; the improvement seems to have been maintained.

MALIGNANT DISEASE OF THE THYROID GLAND—MALIGNANT GOÎTRE

Malignant disease is more prone to affect goîtrous than normal glands.

Round and spindle-celled sarcoma is occasionally met with in the thyroid gland, but is very rare. The tumour is highly vascular, and may pulsate.

Primary carcinoma is a rare disease, and may affect one lobe or the entire gland. It begins in overgrowth of the cubicle epithelium lining the vesicles. A peculiar form of malignant disease is sometimes met with in which the tumour and its secondary manifestations, which appear in the bones and viscera, present microscopic characters of the normal gland (*thyroid cancer*).

Malignant goître runs a rapid course, secondarily implicates the glands in the neck, and may grow into the trachea. Sooner or later pressure symptoms make their appearance and become very serious. The gland is usually irregular in outline, and soon becomes fixed.

Treatment.—In the early stages removal of the gland may be practised, but as a rule this is negatived by the extent of the disease and evidence of secondary infiltration of the glands. Pressure on the trachea or spasm of the larynx, due to involvement of the recurrent laryngeal nerve, may necessitate a low tracheotomy or laryngotomy; the difficulties of the former operation are great, since the enlarged gland not only lies in front of the trachea, and may require division with the Pacquelin's cautery, but has often displaced the tube; a tracheotomy tube long enough to pass the obstruction will be necessary.

PARTIAL REMOVAL OF THE THYROID GLAND

The part to be removed is exposed by a free longitudinal incision, care being taken to avoid large venous trunks; not infrequently the internal jugular lies in front of the tumour. The depressors of the hyoid are separated and hooked aside, or, if necessary, may be divided. The lobe to be removed is now carefully isolated, the sterno-mastoid muscle and large vessels of the neck being held aside with retractors. The superior and inferior thyroid arteries must be defined and divided between two ligatures; great care must be taken not to damage the recurrent laryngeal nerve which runs with the inferior thyroid. When the vessels have been secured the lobe can be drawn forwards towards the middle line, and the isthmus separated from the trachea by a blunt instrument; beneath it will be found the inferior thyroid veins, which may be very much enlarged. The isthmus should be ligatured in two or more pieces with silk, and divided about half an inch beyond this point. The wound is closed except below, where a small drainage tube should be inserted for a few days.

REMOVAL OF THE THYROID ISTHMUS

This operation is undertaken in cases of goître with the view of inducing atrophy of the lobes, and to relieve urgent or spasmodic dyspnœa. The isthmus is exposed by an incision in the middle line, and any veins met with are double ligatured and divided. Isolation of the isthmus is effected by the finger and a blunt instrument, and when it has been separated from the trachea it is ligatured in two or more pieces on each side close to the lobes, and the intervening portion removed or merely divided. Consecutive atrophy of the lobes is sometimes rapid.

CHAPTER XIV

DISEASES OF THE JAWS[1]

PERIOSTITIS—PERIOSTEAL ABSCESS

PERIOSTITIS of the jaws may result from injury, tubercle, syphilis, the acute exanthemata, and poisoning by mercury or phosphorus, but is most usually due to the irritation of decayed teeth. The disease may be acute or chronic—the former frequently ends in suppuration and necrosis; the latter causes enlargement from the deposition of new bone accompanied by constant neuralgia, especially if decayed stumps are present. The signs of periostitis have been already described at p. 118. If suppuration results, the pus may travel in various directions, indicated under Necrosis, p. 316.

Treatment consists in the removal of stumps or carious teeth, and of all causes of irritation, coupled with free evacuation of pus by incisions down to the bone (made from within the mouth if possible), in order that necrosis may be prevented. In chronic cases iodide of potassium will be found very beneficial.

ALVEOLAR ABSCESS

The irritation of decayed teeth, especially if they are hollow, and the cavity (which may have been plugged with stopping) is the seat of septic material, may excite suppuration at the root of the fang. The abscess sac may be very small; but if the condition has progressed insidiously, and been present for some time, it slowly enlarges, and a considerable sac with dense fibrous walls expands the jaw. In the case of the upper jaw, the antrum may become involved if the second bicuspid or molars are the originators of the mischief, since the fangs of these teeth may project into the cavity. There is intense persistent toothache owing to the periosteal inflammation; the gum and soft structures are swollen and tender, and percussion on the diseased tooth causes exquisite suffering. If the fang be extracted the symptoms quickly subside, although the pain may be pretty severe for some hours after, owing to tearing of the inflamed periosteum by the operation. At the end of the fang a small sac will be seen, which has been ruptured by the extraction. If, however, the case be neglected, the suppuration continues until a considerable abscess is formed, which usually bursts into the mouth or beside the tooth, or, in the case of the upper jaw, into the antrum or perhaps the nasal fossa, according to the situation of the offending tooth. In some cases the patient is ill from want of rest and constant pain, and there may be slight fever and constitutional disturbance. The glands at the angle of the jaw may be enlarged and tender, and occasionally suppurate. Necrosis of the jaw sometimes results.

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[1] For Leontiasis, see p. 115; for Actinomycosis, see p. 139, vol. i.

Treatment.—All decayed stumps at the seat of mischief should be at once extracted, in order to cut short the process. If this be done early, the patient is at once relieved, and further mischief is prevented. In more advanced cases the pus must be given free exit by suitably placed incisions within the mouth, supplemented by others in the neck when the pus has burrowed in that direction.

If a tooth is plugged with stopping, it is not always necessary to sacrifice it, if the patient will submit to having the stopping extracted, the pulp cavity cleansed, and the fang drilled, so that the pus can be evacuated. Teeth treated in this way may last another two or three years, but rarely longer.

NECROSIS OF THE JAWS

Etiology.—Necrosis of the jaws is consequent on acute periostitis, which may arise from any of the causes already mentioned. Formerly, phosphorus and mercury poisoning not infrequently produced necrosis; match-makers are now rarely affected, partly owing to the operation of the Factories Act, and partly to the compulsory use of red amorphous phosphorus. Cancrum oris, and other ulcerative processes in the mouth may occasion necrosis as the result of extensive sloughing of the soft structures and periosteum. Necrosis of the lower jaw is more frequent than of the upper, owing to its different structure and less vascularity.

Morbid anatomy.—The extent and situation of the necrosis depend upon its cause. Large portions of the jaw may die, or the process may be limited to the alveolar border, or, in the case of the lower jaw, to one table, usually the outer. The most extensive destruction occurs as the result of periostitis induced by some specific poison, as in typhoid, scarlet fever, or one of the acute exanthemata. The course taken by the pus depends upon the seat of the necrosis; in the case of the upper jaw the abscess may burst into the antrum, the floor of the nose, or may pass to the uvula or soft palate along the roof of the mouth.

Abscesses in connection with the lower jaw open into the mouth, usually in the buccal groove; they may extend into the neck beneath the deep fascia, and the pus may pass a considerable distance downwards towards the clavicle. In phosphorus necrosis the sequestrum is usually of a peculiar green colour, and is surrounded by soft, pumice-stone-like new bone, which comes away with it.

Signs.—The patient complains of constant severe aching pain, which he probably attributes to toothache. Removal of carious stumps does not cure the pain, although, by removing a source of irritation and periostitis, and by affording an outlet for the pus, it may alleviate it. The gums are tender, swollen, and congested, and the teeth become loosened and may be easily removed by the finger.

There will be local signs indicative of the formation of pus, and abscesses, unless opened, will burst in one or other of the directions indicated.

The discharge of pus into the mouth renders the breath very offensive; and if the patient swallows the decomposing discharge he may suffer from gastric disturbance, and perhaps some constitutional symptoms, from absorption of poisonous material. Constant pain, discharge, and inability to take appropriate food soon lower the patient's general health.

Prognosis.—The dangers to be apprehended are septic absorption, or septic bronchitis and pneumonia; but these are fortunately rarely met with if due antiseptic precautions be taken, and the discharge be given free outlet.

The extent of repair after necrosis depends upon whether the periosteum remains intact or has been destroyed by sloughing. In the lower jaw it may be perfect, but in the upper it is much less so.

If the periosteum has suffered, the repair of the jaw will be by fibrous tissue, which may, however, be very dense.

If necrosis of the alveolar border occurs in young children, the germs of the permanent teeth will usually be destroyed.

Treatment.—Necrosis of the jaw is treated on the same principles as necrosis elsewhere. The sequestrum should not be interfered with until it is loose, and must then be removed through the mouth. Pending its separation, all carious teeth and sources of irritation should be removed, and the pus given free exit by suitably placed incisions of sufficient length. Antiseptic mouth washes and the use of iodoform are very important. Washes of quinine or Condy's fluid are good, and Listerine will be found very efficacious and pleasant.

SUPPURATION WITHIN THE ANTRUM—EMPYEMA ANTRI

Etiology.—Pus in the antrum is usually due to suppuration occurring round a fang of one of the teeth projecting into its floor (especially the first molar), or to the bursting of an alveolar abscess. It may also occur as the result of a fracture implicating the cavity, of catarrh spreading from the nose, or the irritation of a growth or foreign body which may have penetrated the walls.

Signs.—The case is usually chronic, and its true nature is not infrequently overlooked. There is constant aching neuralgic pain, sometimes referred to the frontal region, and often associated with severe headache; the pain may be temporarily increased in severity from accumulation of pus due to blocking of the outlet into the nose. Occasionally the pain is but slight. The patient may notice in the morning that there is a discharge of pure, often fœtid, pus from the nostril if he has lain upon the opposite side. He is aware of an intolerable fœtid smell, which, contrary to what is met with in ozæna, is not experienced by those with whom he converses.

The escape of pus into the nose by partially relieving the distension of the antrum prevents its expansion, and hence bulging of the cheek or egg-shell crackling from thinning of the bone is very rarely seen; but these signs may occasionally occur in very chronic cases, especially if the pus has become inspissated, and forms a more or less dense mass in the antrum. If the patient swallows quantities of putrid pus, digestive troubles, with anorexia, may result.

In suspected cases the teeth should be carefully examined and necrosed stumps extracted. Examination of the middle meatus of the nose may demonstrate the escape of pus from the antrum, or catheterisation of the cavity may be practised. Trans-illumination is an important diagnostic aid in determining the presence of a tumour or fluid in the antrum. The patient being in a dark room, a small electric lamp, round the handle of which the lips are closed, is placed in the mouth. If the antra are normal, a band of light is seen beneath each eye; but if one is occupied by opaque fluid or by a solid growth, that side remains un-illuminated.

Treatment.—The abscess must be treated by evacuation and antiseptic irrigation. If the teeth are diseased, they should be removed, and pus may then flow through the socket, or the socket of the second molar may be drilled with an ordinary gimlet, care being taken that on entering the cavity it is not allowed to slip upwards too far or the orbital plate may be wounded. The antrum may also be opened through the canine fossa; after it has been opened, the cavity should be explored with a probe, to ascertain whether a tumour or foreign body be present. It should be freely irrigated with boracic acid or iodine solution, and kept open until all discharge ceases; if this does not take place, an examination should again be made with the view of removing any irritant, or providing better drainage. The patient can conveniently wash out the cavity through a Eustachian catheter. The drill-hole should be filled with a small plug on a vulcanite shield moulded to the gum, so that no food can enter the antrum during mastication.

HYDROPS ANTRI

The antrum is occasionally distended with clear fluid, probably due to the formation of a cyst in connection with the mucous follicles of its lining membrane. The affection is usually quite painless, and undiscovered until the distension of the cavity causes bulging of the cheek or pressure on the globe. An escape of clear fluid from the nostril is indicative of the condition. The treatment consists in free evacuation by an opening at the canine fossa, coupled with removal of the cyst wall if possible, or destruction of the secreting surface by the application of a solution of chloride of zinc, grs. 40, or silver nitrate, grs. 20, to the ounce of water.

TUMOURS OF THE ANTRUM

Innocent tumours—**Fibroma, enchondroma,** and **osteoma** occasionally originate in the upper jaw, but all are rare. These tumours, especially the fibroma, may attain a very large size and encroach on the cavities in immediate connection with the jaw, or originating in its neighbourhood gradually invade the antrum. Innocent tumours are characterised by their slow and painless growth, but when they have attained a large size they may lead to extreme neuralgic pain from pressure on the branches of the fifth nerve.

Polypus.—A polypus of the antrum may originate as an overgrowth of the mucous membrane or submucous tissue, or may be an ordinary nasal polypus which has invaded the cavity. These tumours are soft and composed of delicate fibrous tissue with numerous blood-vessels; occasionally they are cystic. Polypus rarely causes symptoms, but may excite suppuration, or if large, will cause all the signs to be presently given, consequent on distension of the cavity.

Treatment consists in laying open the antrum opposite the canine fossa and removal of the growth by avulsion.

Malignant tumours—**Sarcoma** and **carcinoma** may originate within the antrum, or spread to it from the palate, nose, or pharynx.

Spindle- and round-celled sarcoma and the myeloid variety are met with, and sometimes the vascular element is so great that the tumour pulsates.

Epithelioma originating within the antrum is of the columnar-celled variety, the squamous form may spread to the jaw from the gums, palate, or nose. Epithelioma of the palate shows a special tendency to perforate the bone and invade the antrum (*boring epithelioma*, see p. 326).

Malignant tumours grow rapidly, but do not cause much pain until they compress the nerves; growing primarily within the antrum they remain limited by its bony walls for a considerable time, but as these become absorbed the tumour fungates in different directions and grows more rapidly.

Signs of antral tumour.—All tumours, whether innocent or malignant, when they have attained sufficient size distend the antrum and cause bulging and subsequent perforation of its walls, the thinnest parts being the first to yield.

The patient complains of dull aching pain, which is sometimes agonising and neuralgic; the nasal fossæ are encroached upon, and if suppuration has occurred there may be some discharge from the nose; later on the tumour spreads into the nose, and may even project from the nostril or into the pharynx. The nasal duct is often obstructed and epiphora results.

Pressure on the orbital plate at first causes diplopia, but as the pressure becomes extreme the growth may invade the orbital cellular tissue and push forward the globe; blindness and sloughing of the cornea sometimes result from pressure on the fifth nerve.

The palate is slightly bulged and the line of the teeth may be irregular. Bulging outwards leads to deformity of the face, and in the case of malignant tumours the skin may become involved and the growth ultimately fungate on the surface. When a tumour escapes from the antrum by erosion of its walls, it may send processes in many directions, but this involvement of adjacent parts is most evident in growths originating in connection with the jaw, but not within its cavity. Spreading into the nasal fossæ both jaws may be affected, as happened in a case of mine in which I successfully removed both bones. The growth may extend into the sphenoidal sinuses or temporal fossæ, or may come forwards beneath the cheek between the pterygoid muscles; lastly, it may extend into the skull through the orbit or the numerous foramina at the base.

Treatment—Removal of the upper jaw.—Tumours of the upper jaw must be treated by complete or partial removal of the bone. In cases of innocent growths it is not necessary to remove the whole bone, provided free access to the tumour can be obtained by a partial operation. Epithelioma of the palate may be removed without sacrificing the upper segment of the jaw, provided it has not invaded the antrum. If a growth of a malignant nature has fungated on the skin and spread to the neighbouring cavities, the propriety of its removal must be determined by following the usual rule for guidance in the treatment of malignant tumours generally—no operation should be performed unless there is a reasonable hope that all the disease can be removed or, failing this, that the operation will effect great amelioration of the patient's sufferings.

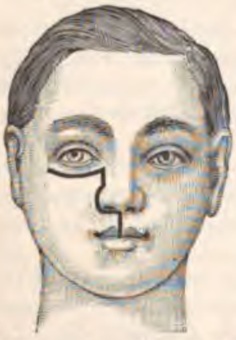

FIG. 105.—Line of incision for removal of the right upper jaw by Fergusson's method. (Tillmans.)

Removal of the upper jaw is best performed by Fergusson's incision (Fig. 105). In bad cases a preliminary tracheotomy and the employment of Trendelenburg's tampon may be necessary, but as a rule this need not be done, provided the surgeon has sufficient and competent assistants, and can plug one side of the affected pharynx with a sponge without interfering with respiration. The patient is conveniently placed with a pillow beneath the shoulders and the head slightly raised; some surgeons prefer the head to be dependent so that the blood flows away from the pharynx, but with a little care the danger of blood passing into the air-passages can be avoided and the raised position is the most convenient. The nostril on the side to be operated on is plugged with a small sponge secured by a piece of silk, and a piece of flat sponge placed between the cheek and alveolar border of the jaw; these sponges prevent blood passing into the nose or mouth during the free hæmorrhage which occurs when the skin flap is raised. The lip is split in the middle line and the coronary artery at once caught in forceps. An incision is now begun at the inner end of the lower margin of the orbit and is carried down the side of the nose, and round the ala to join the cut in the middle line of the lip; the nose is opened. From the upper end of this incision another is made along the lower margin of the orbit and the malar bone to about an inch beyond the outer canthus. The flap thus marked out is rapidly raised and all bleeding is arrested before the next stage of the operation is undertaken. The lower eyelid and orbital periosteum are gently separated from the orbital plate for a short distance.

Division of the bony attachments.—The central incisor is extracted, and with a narrow jaw-saw held parallel to the plane of the palate and introduced into the nose by the side of the septum, the greater part of the thickness of the bone is sawn through. Care must be taken not to point the saw upwards or its point may penetrate the base of the skull, and not to drive it too far backwards on account of the pharynx.

The nasal process of the superior maxilla is then sawn through from within the nose to the orbit, and thus all risk of damaging the globe is avoided.

The outer bony limit is divided by sawing from the cheek towards the orbit, the saw being placed at about the junction of the outer third, with the inner two-thirds of the lower margin of the orbit, so that the cut will pass into the spheno-maxillary fissure.

With a strong pair of bone forceps the division of the bone which the saw cuts has begun is completed.

The jaw is now seized with lion forceps, one blade being on the orbital plate, the other on the palate; it is rapidly and forcibly twisted outwards, its complete isolation being effected by dividing the soft from the hard palate.

As soon as the jaw has been removed, a sponge is crammed into the cavity to arrest the bleeding. It is then carefully removed, and the infra-orbital artery will be found spurting at the bottom of the wound and may be easily secured or touched with the cautery. Any bleeding points which do not stop with pressure may be lightly cauterised. It not infrequently happens, especially in the case of malignant tumour, that directly the jaw is seized in lion forceps, it breaks up and cannot be removed whole; and the bleeding is sometimes very severe and immediately dangerous. In such cases I have found it a good plan to arrest the bleeding by sponge pressure, and then prize the jaw forwards with a periosteum elevator, using one hand as a fulcrum.

The surface of the wound is lightly dusted with iodoform, and the skin flap very accurately brought into position and fixed with silkworm gut and horsehair sutures. The line of incision should be covered with a thin layer of salicylic wool and collodion.

After-treatment.—This consists in careful feeding through a tube, and the most scrupulous cleanliness. The wound should be freely irrigated many times a day with Condy's fluid, and iodoform must be dusted over it night and morning. Repair is rapid, and in three or four months a tooth-plate may be fitted by a skilled dentist.

Partial removal of the upper jaw.—The knife is placed in the nostril on the side to be operated on, and its margin and the lip are divided so that the actual incision made is increased in length by that of the nasal aperture. The flap can be dissected up a considerable distance and gives ample room for the succeeding operation. The palate is sawn and divided with bone forceps as above described, and the division of the jaw is effected by sawing it in half from the nose towards the cheek. The soft palate is separated from the hard and the isolated portion of jaw twisted out with lion forceps.

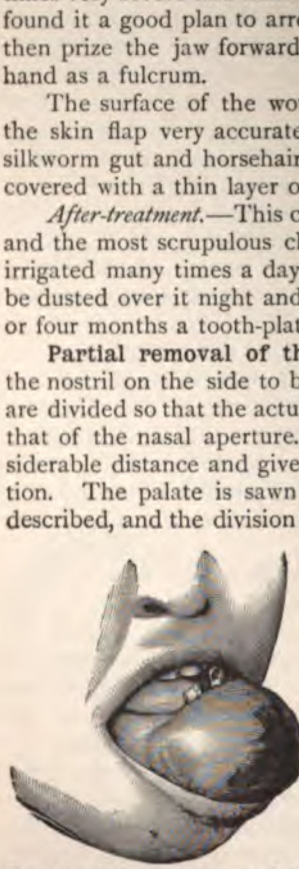

FIG. 106.—A fibro-cystic tumour of the lower jaw. It was removed by Key from a child æt. thirteen; it had been growing two years (Follin, after Key).

TUMOURS OF THE LOWER JAW

Innocent tumours — Fibroma, osteoma, and **enchondroma** may grow from the periosteum or within the bone. These tumours are usually painless and grow slowly. They are readily removable and do not recur.

Epulis is described at p. 325.

Malignant tumours—Sarcoma may, as in other bones, originate from the periosteum or within the substance of the bone. The tumour sometimes reaches a very large size, and may perforate the bone and fungate into the mouth or through the skin. Sarcomata are sometimes cystic, and may be largely mixed with fibrous tissue or cartilage.

The appearance of the growth may be preceded by severe neuralgic pain in the jaw and the teeth may be loosened; as the jaw is expanded egg-shell crackling may be detected.

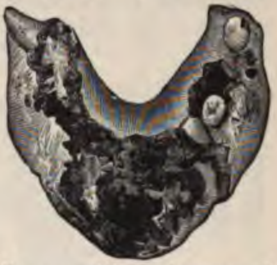

FIG. 107.—Fibro-cystic tumour of the lower jaw; the specimen removed from Fig. 106 (Follin, after Key).

Squamous epithelioma may originate in the palate or gum and gradually invade the jaw (see p. 326).

Cystic epithelioma (epithelial odontome) is a rare growth only met with in the jaws, and especially affects the lower.

Epithelioma may be excited by the continued irritation of a bad tooth. According to Eve, the cystic form is due to invasion of the jaw by the deeper cells of the epithelium of the gum, which grow into columns separated by a fibrous stroma. The cystic cavities are due to degenerative changes in the cells.

The tumour as it increases in size expands the jaw, and may fungate through the skin. It is apparently of slight malignancy, and early removal is very satisfactory. These tumours grow slowly and may occur in young patients.

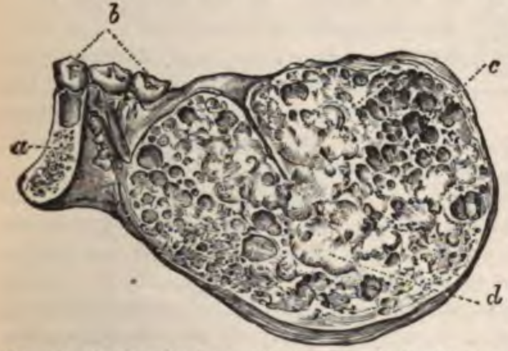

FIG. 108.—Cystic epithelioma of the lower jaw (epithelial odontome). *a*, divided bone; *b*, teeth; *c*, cysts containing a glairy fluid; *d*, lobules of growth. The cystic spaces are lined by columnar epithelium cells, and filled by round ones which are undergoing mucoid degeneration. The interlobular tissue is mostly composed of spindle cells which in some parts have developed into fibrous tissue (Pepper).

Treatment—Removal of half the lower jaw. — Removal of the portion of jaw involved is essential. It is better to remove the entire half of the jaw than to leave the ramus, even although it is not diseased, for if it be left the pterygoids pull it forwards, and this causes considerable irritation and pain; moreover, the ramus is useless.

Similar precautions must be taken to prevent blood passing into the mouth, as in removal of the upper jaw, but the danger of its occurrence is much less. The head and shoulders should be well raised. If the tumour is large the lip may be divided in the middle line to give more room, otherwise, especially in women, this need not be done, and the incision may be begun opposite the symphysis. The skin is slightly drawn upwards (so that the subsequent scar is less noticeable) and an incision is made down to the bone from the symphysis to the lobule of the ear, the outline of the jaw being followed. The facial artery and other vessels are at once secured. The flap is now dissected up and the buccal mucous membrane divided. When the central incisor has been extracted the symphysis is sawn through just external to the attachment of the tongue muscles, the jaw is forcibly drawn outwards, and the soft structures on its inner aspect divided as far back as the ramus. By depressing the bone the pterygoids and temporal muscles are brought into view and divided; the capsule of the joint is opened and the jaw disarticulated, care being taken that the internal maxillary artery is not cut, an accident which may easily happen if the jaw be twisted outwards.

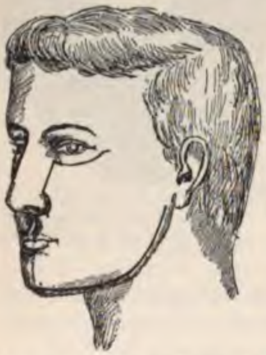

FIG. 109. – Line of incision for removal of the upper jaw by Fergusson's method and for removal of half the lower jaw. The dotted part of the incision through the lower lip should not be made unless more room is required.

Clearing the ramus and the coronoid process is difficult, and may be greatly facilitated by an assistant forcibly retracting the skin flap upwards. If the neck of the condyle gives way it can readily be removed before the wound is closed.

The wound is accurately sutured and dressed as after removal of the upper jaw, and a drainage tube should be inserted at the most dependent part.

The after-treatment is similar to that necessary after removal of the upper jaw. The patient should be propped up in bed and slightly turned to the opposite side, so that saliva and discharge do not accumulate in the wound. In the case of tumours implicating the symphysis, care must be taken that the tongue is secured by a thread, or it may fall back owing to the attachment of the genio-hyoglossi having been divided.

DISEASES OF THE GUMS

Hypertrophy.—Simple overgrowth of the gums is uncommon. The new tissue grows up round and more or less conceals the teeth. If necessary the redundant portion may be cut away or removed by Pacquelin's cautery.

Gingivitis — Spongy gums. — Inflammation and a spongy condition of the gums may be due to poisoning by lead or mercury, to digestive disturbance, to scurvy, to the irritation of decayed stumps, or the accumulation of tartar in those who neglect the use of a tooth brush. In all forms of stomatitis the gums participate. They are swollen, tender, red, and may be superficially ulcerated; the breath is foul and the patient is unable to take solid food on account of the pain caused by mastication. The general appearance of the gum differs somewhat with the cause of the affection.

Treatment.—The chief indication is to remove the cause of the inflammation and improve the patient's health by good food and tonics. Locally the frequent use of an astringent mouth wash of chlorate of potash or alum is all that is necessary.

TUMOURS OF THE GUMS AND ALVEOLAR BORDERS OF THE JAWS

Epulis.—The term epulis indicates the situation of a growth and not its nature. Two forms are usually described—the fibrous and the myeloid.

Fibroma.—A fibroma may spring from the gum itself, but more usually arises in connection with the periosteum of the alveolar border, especially of the lower jaw. Fibroma is more common in women than men, and usually occurs in early adult life. The growth is probably excited by the irritation of decayed stumps. A fibroma is broadly sessile, elastic, smooth on the surface, and covered with unaltered mucous membrane in its early stages, but subsequently the surface ulcerates from being bitten or otherwise irritated. It grows slowly without causing pain or involvement of the glands, and does not spread to the adjacent tissues. The teeth may be loosened and displaced, or are concealed by the growth.

Myeloid sarcoma resembles a fibroma, but grows more quickly, is softer, ulcerates more readily and tends to spread to adjacent parts, and unless freely removed will return after operation.

Treatment.—Fibroma and myeloid sarcoma must be removed with the alveolar border from which they spring. A tooth is extracted on each side of the growth, and the gum being divided with a knife the jaw is sawn through to a sufficient depth to clear the base of the growth. The portion thus marked out is then cut away with bone forceps. The mouth must be kept clean by the use of Condy's fluid and iodoform.

Papilloma of the gum is sometimes met with. The tumour presents the usual characters of papillomata of mucous membranes, and is easily removed by the knife or cautery.

Epithelioma of the gums is not uncommon, and may be due to the chronic irritation of decayed stumps or an ill-fitting tooth-plate. The growth forms a fungus or warty-looking mass which speedily ulcerates, grows up round the teeth and invades surrounding parts and the cervical lymphatic glands. Epithelioma of the gum and palate shows a remarkable tendency to invade and deeply erode the bone, and in the latter situation spreads to the antrum (*boring epithelioma*), p. 319. The growth must be distinguished from the fungous granulating foul mass which is not infrequently seen in connection with necrosis of the jaw.

Treatment.—The affected part must be very freely removed, and the cervical glands excised if they are enlarged (p. 322).

ODONTOMATA

The fibrous, radicular, and composite odontomes have been already described on p. 244, vol. i.

Dentigerous cyst—Follicular odontome.—When a permanent tooth is retained the tooth sac may become distended with clear viscid fluid and a tumour, often of considerable size, results. The cyst is lined with epithelium and contains an imperfectly developed tooth usually fixed to the bone at the bottom (Fig. 110). Such tumours are occasionally multiple. Dentigerous cysts usually occur in connection with the molar teeth, and are more often seen in the lower than in the upper jaw. In the former situation the cyst gradually separates the plates of the jaw, and may render them so thin that egg-shell crackling is produced; in the upper jaw the cyst soon invades the antrum. Dentigerous cyst must be diagnosed from a solid tumour. The facts that the cyst usually occurs in children or young adults, that it progresses very slowly and painlessly, and that one of the permanent teeth is missing are the chief diagnostic signs. In cases of doubt the supposed tumour must always be cut into before removal of the jaw is undertaken.

Treatment.—The cyst must be laid open from the mouth by removal of part of its wall. The tooth is extracted and the cavity mopped with chloride of zinc solution (gr. 40 ad ℥i.). The expanded portion of the wall may readily be pressed back into position so that the normal contour of the jaw is restored.

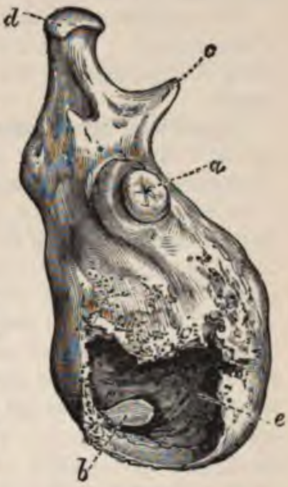

FIG. 110.—Dentigerous cyst of the lower jaw (follicular odontome). To the inner wall of the cyst is attached a retained canine tooth. The cyst was lined with a thick vascular membrane composed of granulation and fibrous tissue, but with no trace of epithelium. From a girl æt. thirteen. *a*, molar tooth; *b*, retained canine; *c*, coronoid; *d*, condyle; *e*, cavity of cyst (Pepper, from a specimen in the Museum of the Royal College of Surgeons, No. 2195).

Epithelial odontome. — Sutton places the peculiar cystic epithelioma of the jaw with the odontomes. The tumour may occur in either jaw, but is more common in the lower (see p. 323).

DISEASES OF THE TEMPORO-MAXILLARY ARTICULATION

Acute inflammation may be dependent upon injury, acute rheumatism, gonorrhœal rheumatism, the acute specific fevers, or may arise in connection with otitis media owing to caries of the tympanic plate. The symptoms are radiating pain (increased by movement) and a swelling over the joint, perhaps with associated fever and constitutional disturbance. Suppuration may or may not occur; if abscess results the pus may be discharged externally or into the meatus auditorius through the tympanic plate. The treatment consists in fixing the jaw by a bandage passing under the chin, and the employment of cold, unless suppuration is imminent, in which case the process should be hastened by heat. If abscess forms the joint must be freely opened. As soon as the inflammation subsides moderate movement should be enjoined to prevent the formation of adhesions. Caries of the joint surfaces occasionally occurs. The diet must consist of slops.

Osteoarthritis is not uncommon and causes more or less pain and fixity. The treatment is given at p. 178.

CLOSURE OF THE JAWS

Permanent closure of the jaws may be due to changes occurring in the joint or in the soft structures.

Ankylosis of the joint may follow acute or chronic arthritis, the bond of union being fibrous or bony. Ossification of the ligaments occasionally occurs.

In suitable cases the condition is readily remedied by excision of the condyle. This is done through a transverse incision running below and parallel to the zygoma, opposite the lower border of the tragus.

Cicatricial contraction of the soft structure may lead to permanent closure. The condition may result from sloughing in consequence of gangrenous inflammation in the course of scarlet fever, measles, or noma ; it may also occur from neglected alveolar abscess and necrosis of the jaw. In such cases every attempt must be made to prevent the formation of cicatricial bands. Should these occur, but not be very extensive, the movements of the jaw may be improved by constant use, or in some cases cure may be effected by dividing the bands and plugging the resulting wound. In the worst cases an artificial joint must be made in front of the band by the removal of a small wedge of bone, the apex being at the alveolar border. This can be readily accomplished through an incision along the lower border of the bone. Movement should be commenced three or four days after the operation.

Spasmodic closure is due to some temporary cause exciting strong contractions of the muscles of mastication, *e.g.* tetanus ; but in most cases the condition is purely local and dependent on difficult eruption of the wisdom tooth.

Spasmodic closure in connection with a misplaced wisdom tooth may, if neglected, lead to permanent fixity in consequence of resulting inflammation and sloughing. The wisdom tooth in these cases is placed too far back in the jaw which is foreshortened ; its eruption is thereby prevented owing to the crown of the tooth looking forward and impinging against the second molar. The patient should be anæsthetised, and the second molar extracted, so that the wisdom tooth may come forward.

CHAPTER XV

Diseases of the Lips, Cheeks, Mouth, and Tonsils

THE LIPS, CHEEKS, AND FLOOR OF THE MOUTH

Hypertrophy of the lips may be congenital or due to syphilitic or tubercular induration. The enlargement usually affects the upper lip and may be very considerable and unsightly; the protruding mucous membrane is liable to painful ulceration and fissuring. The congenital form may be remedied by removal of a V-shaped portion. The acquired form must be treated according to the condition producing it.

Cracked lip.—Painful fissuring of the lips may be due to exposure to cold, especially east winds, or to some constitutional condition such as syphilis. Syphilitic fissures at the angles of the mouth are common and leave thin white cicatrices. Simple fissure is usually seen in the centre of the lower lip; healing is prevented by muscular movement. Sometimes the fissure is tubercular, which is an additional reason for its chronicity. The lip must be kept dry, and the fissure should be covered with collodion; if persistent the crack may be touched with nitrate of silver, or a bistoury may be drawn through the base to divide the superficial muscular fibres; in tubercular cases the ulcer should be scraped. Persistent fissures may be the starting-point of epithelioma.

Ulceration.—Small ulcers may form on the lips, cheeks, gums, or on the mucous membrane of the tongue and floor of the mouth. They may be due to mechanical irritation from a rough tooth or ill-
ndigestion, stomatitis, syphilis, tubercle, or excess of

ts in the application of mel boracis or an
alum or chlorate of potash, together with

such means as are indicated by the cause. If persistent and painful the ulcers must be touched with nitrate of silver. A 10 per cent solution of chromic acid is often very useful, and will usually heal syphilitic ulcers in a few days (see p. 200, vol. i.).

Syphilitic inflammation.—Syphilis in any stage may affect the lips and mouth. The primary sore is sometimes seen, especially on the lower lip; it is indurated and slightly ulcerated on the surface, which is often covered with a scab; there is no pain, and the submaxillary glands are always enlarged. In cases of doubt the use of mercury and the appearance of secondary lesions will clear up the diagnosis. Secondary ulcers may appear on any part of the mucous membrane. Leucoplakia is often seen on the inner surface of the lips, at the angle of the mouth, or inside the cheeks, and presents the same characters and requires the same treatment as does the same condition of the tongue (p. 344).

Stomatitis.—Stomatitis is the name given to certain inflammatory conditions affecting the mucous lining of the mouth, and dependent upon various causes. Mercurial stomatitis has been described in p. 194, vol. i. Indigestion, scurvy, septic infection, and the presence of the oïdium albicans may excite stomatitis.

Aphthous and ulcerative stomatitis is most frequent in young children, who are improperly fed or live under faulty hygienic conditions. It often occurs during teething. In adults the condition is indicative of vitiated health, and may complicate some serious acute disease, and is an unfavourable sign. The mucous membrane of the lips, gums, cheeks, floor of the mouth, and tongue presents small vesicles surrounded by an inflammatory zone; these burst and leave acutely tender, red, circular ulcers. In bad cases the ulceration is more extensive, and the gums are swollen, spongy, extremely tender, and bleed readily; the breath is foul, the glands beneath the jaw are swollen and tender, and there is often some constitutional disturbance.

Treatment.—The bowels must be freely acted upon, and the digestive functions should receive special attention. The diet must be fluid, and taken in small quantities at a time. Bicarbonate of soda, chlorate of potash, bismuth, or the mineral acids should be given in small doses. In the simple vesicular form the local treatment consists in the application of mel boracis, or the parts should be washed over with a solution of alum or chlorate of potash; the painful ulcers may be touched with nitrate of silver if they do not soon heal.

When ulceration is extensive the patient should frequently rinse out the mouth with a solution of alum, borax, chlorate of potash, quinine, or Listerine, and the foul ulcers be dusted with iodoform. When the patient is convalescent he should be given a generous diet and tonics, and, if possible, sent into the country.

Thrush is dependent on the presence of the oïdium albicans, and is met with in young, feeble, and improperly fed children. In adults it may occur during some severe illness, and is usually regarded as a serious sign. The child's mouth is tender and red, and the mucous membrane secretes a thick, tenacious, acid mucus. Small white areas of catarrhal inflammation form on the mucous membrane, and as the epithelium desquamates raw surfaces are left. The child is often ill and fretful, and shows evidence of gastro-intestinal trouble.

Treatment.—The mouth must be kept quite clean, and, after feeding, should be wiped round with a soft piece of rag. The inflamed areas must be treated with mel boracis. Careful feeding and regulation of the bowels is necessary.

Gangrenous stomatitis—Cancrum oris (see p. 115, vol. i.).

TUMOURS OF THE LIPS

Papillomata of the mucous membrane are sometimes seen, and are best treated by snipping away with scissors.

Nævi may be met with in the lips and in the thickness of the cheek, and should be excised or treated by galvano-puncture. In the lip nævi may be injected with carbolic acid; a double-threaded needle is passed through the substance of the lip at the base of the growth, and one thread is then tied on each side of it so that the vessels leading from the nævus are compressed; one minim of pure carbolic acid is now injected into the tumour at three or four spots according to its size, and after ten minutes the ligatures are divided and removed. Inflammation and consolidation follows, but suppuration occasionally happens. The operation may require repetition.

Adenomata of the labial glands are occasionally met with. They form dense, freely movable, painless tumours, and are readily removed by incising the mucous membrane.

Epithelioma most usually occurs in men. It affects the lower lip at the muco-cutaneous margin, sometimes the angle of the mouth, but very rarely the upper lip, except by extension. The growth often begins in a wart, or as a persistent fissure or tubercle which, although repeatedly scabbing, never shows any tendency to heal, but gradually enlarges. When the ulceration extends, the surface is no longer covered with a scab, but presents a foul, unhealthy, indurated base, surrounded by dense, raised, everted edges. The destruction may be very extensive (Fig. 111), the gums being exposed, and the disease spreading to the jaw and mouth. The submaxillary glands are early involved. Death may occur from hæmorrhage and exhaustion, from septic bronchitis, or from pressure of the enlarged glands.

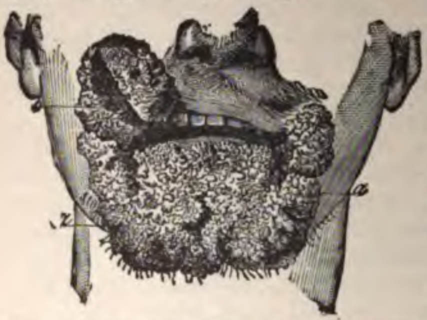

FIG. 111.—Extensive epithelioma of the lower lip. At *b* a part of the growth has been removed (Follin).

Treatment.—When quite small the cancer should be removed by a V-shaped incision extending well beyond its limits; in such cases the prognosis is on the whole good, considering the disease is cancerous. If the disease is extensive a plastic operation suited to the case must be undertaken. When the disease is limited to the lower lip, Syme's operation gives a good result (Figs. 112, 113).

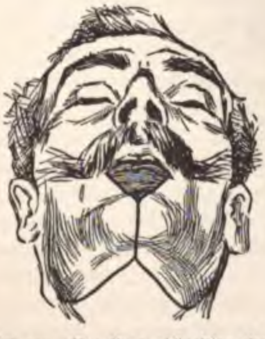

FIG. 112.—The lines of incision for complete removal of the lower lip and its restoration by Syme's method.

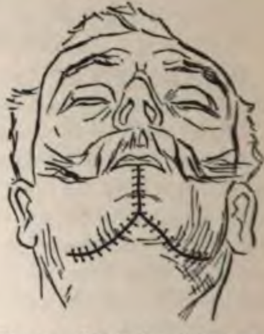

FIG. 113.—Restoration of the lower lip by Syme's method; the operation completed.

CYSTS

Mucous cysts occasionally occur, especially on the lower lip. The tumour is rounded or ovoid, smooth, movable, elastic, and painless; it may be quite translucent. Sometimes these cysts disappear spontaneously. Treatment consists in excision of the tumour and suturing of the mucous membrane with horsehair; the operation is practically painless if the mucous membrane has been previously well painted with cocaine.

Ranula is a general term applied to any cyst in the floor of the mouth. Such a tumour may originate in (1) a mucous gland, (2) Wharton's duct, (3) a sublingual duct, (4) a duct of the gland of Blandin, or (5) in Fleischmann's bursa, which is situated between the genio-hyoid and genio-hyoglossus muscles close to the hyoid bone.

The cyst occupies the anterior part of the floor of the mouth to one side of the middle line. It is quite painless, soft, fluctuating, and may be translucent; it may attain a considerable size, and interfere with speech and the movements of the tongue. The bursal cyst grows downwards towards the neck rather than towards the mouth, and simulates a dermoid, which is, however, distinguished from it by its central position.

Treatment.—The cavity of the cyst should be freely exposed by removal of part of its wall, washed out with zinc chloride, grs. 40 to ℥i., and allowed to granulate from the bottom. If the cyst originates in a salivary duct there is no fear of this being obstructed as granulation proceeds, since the constant passage of the secretion serves to keep it open.

Sublingual dermoids.—The thyroid gland is developed as a diverticulum from the floor of the mouth with which it is at first connected by the thyro-lingual duct; this duct normally becomes obliterated. The duct reaches from the thyroid gland to the foramen cæcum of the tongue, and is divided into two parts by the development of the hyoid bone; the upper part is known as the hyoglossal duct, and if it remains unobliterated it may be the origin of a sublingual dermoid. The duct is lined by epithelium, and may contain sebaceous glands. A sublingual dermoid is situated between the genio-hyoglossus muscles, and may not develop until adult life. The tumour may attain a very large size, projecting downwards beneath the chin, into the neck, and upwards into the floor of the mouth; in rare cases a dermoid has grown so large as to project from the mouth. It is quite painless, gradually increases in size, and may be so soft as to fluctuate. A dermoid is distinguished from a ranula by its median position and want of translucency.

Treatment.—The tumour may be readily enucleated by a median incision through the mucous membrane of the floor of the mouth. Some surgeons advise that the incision should be made beneath the chin so that the floor of the mouth be not opened, a procedure advocated on the ground that the incision through the mouth is liable to be the seat of septic infection, but of this there is practically no danger if due cleanliness be observed, and the patient frequently rinses out his mouth with Condy's fluid or some other antiseptic mouth wash.

DISEASES OF THE PALATE, TONSILS, AND FAUCES

INFLAMMATORY AFFECTIONS OF THE PALATE

Suppuration usually originates in a decayed tooth, or necrosis of the jaw, and may extend beneath the periosteum, and pass backwards to the soft palate. There is considerable pain, with swelling, tension, and congestion of the mucous membrane, indicating the seat of the original mischief. The pus must be given free outlet, and the mouth kept clean by repeated rinsing with Condy's fluid, or some other antiseptic. The removal of the cause is, of course, to be effected.

Syphilis in the secondary stage may be marked by ulceration of the palate, fauces, velum, and tonsils; the ulcers are superficial, greyish in colour, and often very painful (see p. 185, vol. i.). In the tertiary stage gummata beneath the periosteum are not uncommon, and undergo rapid softening, leading to destruction of the bone beneath and perforation into the nose, the bones of which are usually also diseased. Before the gumma has broken down it forms a rounded, elastic, painless swelling; but after this the appearances are similar to those described at p. 345 as being met with in gumma of the tongue. The treatment is that for tertiary syphilis; should perforation result the patient may, when all morbid action has ceased, be provided with an obturator, or an attempt may be made to close the aperture as in congenital cleft palate; such operations, however, often fail.

Tubercle.—Small tubercular ulcers may occasionally be met with on the palate, and may usually be cured by free scraping and painting with a 50 per cent lactic acid solution. In rare cases there is a diffused spongy thickening of the hard and soft palate, the gums, and perhaps of the fauces and pharynx. This may occur independently of any other tubercular manifestation, but is usually associated with lung disease; the glands in the neck may also be affected. Patches of ulceration are present, and the surface may have a definite nodular appearance, appearing in parts like the surface of a raspberry. After a time breaking down may be extensive and result in destruction of the palate, though this is rare. If there is serious lung mischief, the condition is best left alone, otherwise the diseased area should be freely sharp-spooned (there is very free bleeding), and the surface painted with the lactic acid solution. The operation must be repeated as often as necessary. If the disease progresses downwards, the larynx may become involved and tracheotomy may be necessary.

TUMOURS OF THE PALATE

With the exception of squamous epithelioma tumours of the palate are very rare. Sarcoma, nævus, adenoma, mucocele, papilloma, and dermoids are occasionally met with. Dermoids are situated in the middle line, and arise by inclusion during the development of the palate.

Simple tumours should be removed without destroying the palate, but the malignant require removal of the lower half of the jaw (see p. 323).

INFLAMMATION OF THE TONSILS

Acute tonsillitis.—The tonsils, especially in certain people, are specially prone to become acutely inflamed from apparently trivial causes, and such inflammation may recur again and again. The tendency is often hereditary, and affects rheumatic patients. Cold and damp, bad hygienic arrangements, and foul air (as in hospitals) are causative factors. Children and young people especially suffer, the predisposition becoming less marked with increasing years.

Symptoms.—The onset is often very sudden, but may be preceded for some hours by sore throat and some difficulty in swallowing. The symptoms rapidly develop; the temperature rises to 103° or 104° F., and the patient feels and looks very ill. The tonsils are red, congested, and much enlarged, and may meet in the middle line; the glands in the neck may be tender, and the patient complains of great pain and difficulty in swallowing, or in clearing his throat of the abundant tenacious mucus. Pain in the ear is common. When both tonsils are very much enlarged, and especially if suppuration occurs, there may be difficulty in breathing, which causes the patient and his friends considerable alarm.

On examination, the mucous crypts of the tonsil will be seen to be enlarged and filled with a thick, very tenacious, yellowish exudate which is easily recognised from diphtheritic membrane. Superficial ulcers are sometimes present. If suppuration occurs the local and constitutional conditions are deepened, and the affected tonsil bulges forward towards the middle line. Spontaneous and immediate relief follows bursting of the abscess, which is really at the base of the tonsil; the opening is usually either behind or in front.

Treatment.—In the early stages the bowels should be freely acted upon by salines. A gargle of glycerine of tannic acid (ʒi. ad ℥i.), or chlorate of potash (gr. 15 ad ℥i.) should be frequently used, or the tonsils may be painted with stronger solutions. If the local pain be great, much relief will be given by the addition of 5 per cent cocaine. A cold pack to the neck, or ice by the mouth, is often very soothing.

Should suppuration occur, the abscess must be opened with a bistoury, and the cut enlarged with sinus forceps. Great care must be taken to keep the parts clean with antiseptic gargles. The diet is necessarily restricted to fluids.

When the patient suffers from repeated attacks the tonsils should be removed during a quiescent period.

Follicular tonsillitis is a mild affection, resembling in its main features that just described. It appears to be dependent on the staphylococcus or streptococcus pyogenes, and often attacks many people under the same roof. The whole tonsil is enlarged, and the follicles contain a very thick, yellowish-white secretion, which, unlike diphtheritic membrane, can be readily removed. The treatment is that for acute tonsillitis. The occurrence of this condition in a household should excite suspicion as to the sanitation.

CHRONIC ENLARGEMENT OF THE TONSILS—HYPERTROPHY

Young children frequently have enlarged tonsils, independent of any inflammation. In such cases the children are often strumous, have adenoids of the pharynx, and are often more or less deaf. All the children in the same family may suffer. The condition predisposes to acute tonsillitis. In older children and adults repeated attacks of tonsillitis may lead to permanent enlargement. Enlarged tonsils consist mainly of dense fibrous tissue; the mucous crypts are much enlarged, and contain tenacious secretion, in which tubercle bacilli are sometimes found; the signs are similar to those met with in adenoids (see p. 263).

Treatment.—If the enlargement is moderate, and not interfering much with the child's respiration or causing him inconvenience, treatment aimed at the improvement of the general health may be followed by marked diminution in size; but in most cases the tonsils will sooner or later require removal, and as soon as this is evident the sooner it is effected the better.

General anæsthesia is rarely necessary except in the case of young and nervous children, and in deference to the wishes of the parents. If the throat be well painted with a 20 per cent solution of cocaine, the pain is very trifling. Many more or less complicated instruments have been devised for the performance of an operation which is quite simple, and can readily be performed with a curved blunt-pointed bistoury and vulsellum forceps. The surgeon stands in front of the patient, and seizing the tonsil with the forceps draws it to the middle line of the throat, so as to pull it well out from the pillars of the fauces and from the carotid artery; the knife is then passed below the tonsil, which is cut from below upwards, the surgeon making the knife travel with a slight curve conformably with that of the fauces. If this method is not employed, Mackenzie's tonsillotome is a useful instrument. The bleeding is but slight, and stops spontaneously; rarely it is severe, and may require the application of ice or some styptic solution. For a day or two after the operation the patient, if old enough, should use a gargle of chlorate of potash, or the throat may be washed out with tannic acid glycerine. During this time the food should be fluid.

TUMOURS OF THE TONSIL

All tumours of the tonsil are very rare. Epithelioma may spread to it from the tongue or pharynx, or may occur primarily.

Lympho-sarcoma occasionally occurs as an encapsuled, rounded tumour, which causes considerable enlargement and bulging of the fauces, and may grow into and separate the layers of the soft palate. At first the tumour may be easily shelled out; but the glands in the neck become early affected, and later the growth bursts its capsule, invades the surrounding tissues, and forms a fungating mass in the throat.

If the tumour has not infiltrated, it may be removed, thro the mouth, by dividing the structures enclosing it by means of actual cautery. The tumour, when exposed, is easily shelled with the fingers. In some cases these tumours may be remo by external incision along the anterior border of the sterno-mast Recurrence is usually rapid, and occurs in the cervical glands.

DISEASES OF THE UVULA

The uvula may be affected by all forms of inflammation w affect the tonsils and fauces. Sometimes, as the result of repe catarrh, it becomes long and pendulous, and causes sufficient tro to require removal of the redundant portion; but before this is d an attempt may be made to improve the condition by the us astringent gargles, or the occasional application of nitrate of s to the tip of the process.

CHAPTER XVI

Diseases of the Tongue and Salivary Glands

DISEASES OF THE TONGUE

Anatomy.—The tongue is a muscular organ covered with mucous membrane. It consists of two halves, separated by an imperfect fibrous septum, which ends behind at the level of the foramen cæcum. The mucous covering on the under surface is thin, smooth, and devoid of papillæ, which gradually cease at the margins. On the dorsum, the mucous membrane of the anterior two-thirds is beset by papillæ covered by secondary papillæ. At the junction of the middle and posterior thirds is the foramen cæcum, into and round which numerous mucous glands open. Behind this the mucous membrane is thicker, and beset by numerous mucous glands and lymphoid follicles (*lingual tonsil*). The mucous glands are present all over the tongue, but especially on the posterior third of the dorsum. On the under surface, on each side, close to the tip, a collection of these acino-tubular glands lie close beneath the mucous membrane, the numerous ducts opening on the surface. This collection of glandular tissue is known as the gland of Blandin.

The lingual artery lies internal, and the chief lingual vein external to the hyoglossus in company with the hypoglossal nerve. The anastomoses between the arteries of the two sides are scanty.

The lymphatics of the tongue begin in the papillæ and form a plexus of vessels beneath the mucous membrane; these pass to glands situated on the hyoglossus muscles, and thence reach the deep cervical set.

CONGENITAL DEFECTS

Tongue-tie.—Occasionally the frenum is too short, so that the tongue cannot be properly protruded, and the child is unable to suck. Tongue-tie is more frequently diagnosed than seen. All that is necessary is to snip the frenum and tear it sufficiently with the finger; the ranine artery is too deeply seated to be in danger. Care must be taken that the division of the frenum is not too free, or the tongue may fall back and cause difficulty in breathing.

Cleft tongue.—Very rarely the tongue is bifid, like a serpent's. The edges of the cleft should be pared, and united with silkworm-gut.

PARENCHYMATOUS GLOSSITIS

Causes.—Acute inflammation of the tongue is a rare condition. It may be due to local irritation, mercurial salivation, inoculation by specific poisons, the stings of insects, and in some cases appears to be directly traceable to cold.

Morbid anatomy.—The inflammation usually attacks the whole tongue, but is occasionally unilateral. Infiltration with inflammatory exudate is rapid and extensive, so that the organ protrudes from the mouth, and much difficulty in breathing may be occasioned. The swelling may extend to the glottis. Spontaneous subsidence often occurs, but acute abscess, or even gangrene, occasionally results.

Signs.—The onset is sudden. The swollen and tender tongue fills and protrudes from the mouth, the exposed part becomes dry and glazed, and the organ is teeth-indented; there is considerable salivation, with dysphagia and dyspnœa. Slight fever, with constitutional disturbance, is present, and the patient is frightened and anxious, proportionately to the respiratory difficulty. The submaxillary lymphatic glands may be swollen and tender. If the inflammation extends backwards to the root of the tongue and the glottis, the patient's general condition will be much aggravated, and unless speedy relief be given, death from asphyxia may result.

Treatment.—In mild cases the inflammation may subside under the use of astringent lotions, and the removal of all causes of irritation; the bowels must be freely opened, and fluid food administered until the inflammation has been arrested. Usually more active means are necessary, and are productive of immediate relief. A free incision, about a third of an inch in depth, should be made on each side about half an inch from the septum; the exudate quickly drains away, and relief is prompt and permanent. If the glottis is affected and there is urgent dyspnœa, laryngotomy must be at once performed.

CHRONIC ABSCESS

Chronic abscess of the tongue is rare, and its causation doubtful. In a case recently under my care, it was the result of a deposit of tubercle in the substance of the tongue. The abscess is small, quite circumscribed, and painless; the overlying mucous membrane may be normal in appearance, or, if the abscess is near the surface, becomes glazed and shiny, and yellow pus may be seen through it. The diagnosis from a cyst, a gumma, or a solid tumour is often impossible without an exploratory incision.

The treatment consists in free incision and evacuation of the pus, followed by the frequent use of an antiseptic mouth wash. If the abscess is tubercular, the affected portion of the tongue should be removed, or the abscess cavity freely sharp-spooned.

ULCERATION OF THE TONGUE

Ulcers may form on the tongue as the result of injury, tubercle, syphilis, cancer, dyspepsia, and any local cause inducing inflammation. The specific forms are separately considered.

Traumatic ulcers may extend deeply and be accompanied by considerable induration, so that the condition may closely resemble cancer. The discovery of some source of irritation is suggestive of the nature of the mischief; but in cases of doubt, a small piece of the margin and adjoining substance of the tongue should be removed and examined microscopically. Traumatic ulcers and fissures may be the commencement of epithelioma. The treatment of traumatic ulcer consists in filing the teeth, or remedying any source of irritation, coupled with the use of a mouth wash such as recommended for superficial glossitis.

Dyspeptic ulcers are usually met with in tongues which are flabby, furred, and teeth-indented. They are most frequently present along the margins of the anterior half, and are often associated with painful ulcers of the gums, tartar round the teeth, and evident ill-health and dyspeptic symptoms. They speedily improve under general treatment directed to their cause, and the use of a mouth wash of chlorate of potash.

ACUTE AND SUB-ACUTE SUPERFICIAL GLOSSITIS

Inflammation of the mucous surface of the tongue may be due to mechanical injury or irritation, to corrosive poison, scalds, and excessive smoking. Tubercular and syphilitic inflammations are separately described. Superficial glossitis may or may not be accompanied by loss of substance and ulceration, according to its cause. Traumatic irritation usually affects the margins, being the result of rough teeth or an ill-fitting dental plate. In the non-ulcerative affection the mucous membrane loses its epithelium, and presents a smooth, glazed, raw surface, which is very tender owing to the denudation of the highly sensitive papillæ. The pain is increased by mastication, by hot or pungent foods, or by sucking. This condition may pass into the chronic form, to be presently described.

The treatment consists in removal of the cause, and the employment of astringent unirritating mouth washes, such as bicarbonate of soda or potash, grs. 10 ad ℥i., honey and borax, glycerine and borax, glycerine of tannin, alum, or chlorate of potash. During the acute and tender stage the diet should be mainly slops, with bread and milk, and similar articles which require but little mastication. Ice gives considerable relief.

CHRONIC SUPERFICIAL GLOSSITIS

WANDERING RASH—ANNULUS MIGRANS

This peculiar condition is occasionally seen in children, much more rarely in adults. It is a superficial inflammation of the mucous membrane, but its cause is unknown. It cannot be said to be syphilitic or parasitic, but is often indicative of general debility, and possibly occurs in connection with changes in the peripheral nerves.

Signs.—One or more small, red, smooth areas occur on the anterior two-thirds of the dorsum of the tongue; these gradually enlarge and form smooth, red rings with a definite margin of a yellowish colour. These rings vary in size from time to time, and may quite disappear only to be replaced by others; meeting each other at various points the tongue may be mapped out into patterns of various shapes (*geographical tongue*). There are no signs of inflammation, no pain or discomfort, but occasionally there is slight itching with salivation. The disease may last for years and does not appear to be fraught with any ill-consequences. Local treatment is useless, but if there is much itching some mild application such as honey and borax should be used; in view of the frequent association of the condition with general ill-health good food, cod liver oil, and tonics should be administered.

LEUCOMA—LEUCOPLAKIA—SMOKER'S TONGUE—PSORIASIS OR ICHTHYOSIS LINGUÆ

Etiology.—Leucoma is especially met with in men during adult life. It is attributed to many causes which induce chronic irritation, and probably in any given case many causes co-operate. Incessant smoking, the irritation caused by hot and pungent foods, ardent spirits, rough teeth, chronic ulceration, and especially syphilis, may all occasion the condition. It is highly probable that underlying the exciting cause there is some natural predisposition of the mucous membrane, the epithelium cells being abnormally thin and unstable. Leucoma is by no means confined to the tongue, but is frequently met with on the mucous membrane of the lips and on the cheek, especially along the line at which the upper and lower teeth meet.

Morbid anatomy and signs.—The disease may be quite localised, or affect more or less of the whole dorsal surface and margins of the tongue; the under surface nearly always escapes. Preceding the formation of the white patches, which are characteristic of the disease, the mucous membrane loses its papillæ and becomes smooth, glazed, raw-looking, and tender; it is thinner than natural, but still retains its softness and suppleness; it may be fissured. During this stage there is a sense of discomfort with burning, smarting pain, aggravated by hot foods, by smoking, or any other form of irritation. Later on, when the leucomatous plaques form, the epithelium loses its transparency, and hence assumes a dead white colour; although it is thinner than natural it appears on examination to be thickened; the cells are horny. Between the individual plaques the mucous membrane is smooth and redder than natural, and the tongue appears over-clean. The white horny epithelium may separate, leaving a raw hyperæsthetic surface which again becomes covered with epithelium, or may be the seat of ulceration. Patches of destruction or nodular thickenings in the tongue may be the immediate precursors of cancer. When leucoma is fully established, the discomfort is increased and there is a feeling of stiffness.

If all sources of irritation be avoided the disease may be arrested, and in the early stages cured, but in most instances it gradually extends over the whole tongue. It may last for years without producing any real harm, or even being recognised by the patient.

After reaching a certain stage the disease may remain stationary for an indefinite period, but leucomatous tongues not infrequently become cancerous, and ulceration occurring in such should always receive prompt attention. Irritating applications, in the vain hope of curing the patches, may do much harm and excite epithelial invasion of the organ.

Treatment.—All irritants must be avoided. Smoking should be prohibited, or if indulged in the patient should smoke but little of the mildest and coolest tobacco in a pipe with a smooth, rounded mouth-piece. Hot drinks, neat spirits, liqueurs, curries, sauces, and the like are to be avoided. Rough tooth-plates and jagged teeth must be filed down. As regards local treatment it must be insisted on that all forms of caustic do harm. A mouth wash should be occasionally used, especially if the disease shows signs of progressing; for this purpose glycerine of borax, honey and borax, bicarbonate of soda or potash, alum and chlorate of potash are the most suitable remedies. Mercurial mouth washes and anti-syphilitic remedies should be employed in syphilitic cases; a solution of chromic acid (gr. ½ ad ℥i) is very useful. If ulceration occurs and the sore does not readily heal the affected portion must be freely excised. In very bad cases, especially if there is deep fissuring and considerable discomfort, removal of the tongue may be performed, and is imperative if persistent ulcers or indurated patches are present.

SYPHILIS OF THE TONGUE

The primary chancre is occasionally met with and is usually situated at the tip or anterior margin. The sore is painless, circumscribed, and indurated; the lymphatic glands beneath the jaw are enlarged and hard, and secondary symptoms supervene.

Secondary ulcers and fissures are very common and occur when the throat is affected. They may persist for a long time, and the fissuring is often permanent. The ulcers are commonly seen along the margins and are liable to be made much worse if irritated by the teeth. They are quite superficial, often stellate in outline, and of a grayish-white colour. Similar ulcers or mucous tubercles may be met with on the dorsum of the tongue, on the gums, fauces, palate, lips, and buccal mucous membrane. The ulcers cause a sense of stiffness and smarting, and the pain may be very annoying. When the ulcers heal they may leave white patches of leucoma which may subsequently be the seat of fresh ulceration.

Treatment.—In addition to the constitutional treatment applicable to syphilis local treatment is very beneficial. If the teeth require it they should be filed so that the ulcer is not further irritated.

Mercurial mouth washes are very useful, but, perhaps, the best local remedy is a 10 per cent solution of chromic acid, which should be applied to the ulcers twice daily after the surface has been dried. The improvement is often surprisingly rapid. The food must be unirritating, and smoking must be prohibited.

Tertiary manifestations.—Gummatous disease of the tongue may lead to the formation of nodular elastic swellings, which break down and leave ragged ulcers, or if the inflammation is more diffuse, deep fissures result which may traverse the tongue in all directions. Gummata of the tongue occur more often in men than women. They are usually situated on the dorsum, in the posterior half, towards the centre of the organ; and may be comparatively superficial or more deeply seated; they are frequently multiple. Before it has broken down a gumma forms a perfectly circumscribed, rounded, elastic, painless tumour, it is not indurated, and does not cause salivation, or affect the speech. In this stage the gumma is often unnoticed, attention being drawn to it only when it has softened, and having burst on the surface has produced the characteristic ulcer. The edges of this are deeply cut, ragged, and undermined, and the base is covered with a yellowish, adherent slough like wet chamois leather. Breaking down may be prevented by the timely use of iodides.

Syphilitic fissures due to gummatous ulceration may be very extensive and furrow the tongue in all directions. The edges are usually smooth and steep, and the surface resembles the base of a circumscribed gumma. When healing takes place the fissures are much contracted, and remain permanently.

Fissuring may also occur independently of ulceration, and is due to chronic inflammation with the formation of scar tissue (Fig. 114); the fissures in such cases correspond to the tracts of new fibrous tissue, and are produced in a similar manner to those seen in hobnailed liver. Leucoma is in many cases syphilitic in origin (p. 243).

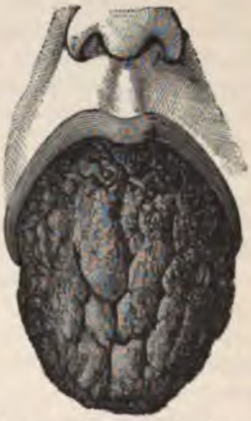
FIG. 114.—Extensive fissuring of the tongue following syphilitic ulceration (Follin, after Clarke).

Treatment.—Tertiary syphilis of the tongue must be treated by iodide of potassium, which should be pushed until a decided effect is produced; under its use healing rapidly takes place. Locally a mouth wash of chlorate of potash, bicarbonate of soda, or alum should be employed, or the patient may use glycerine of tannic acid or borax; before these are applied, the tongue should be carefully dried. Tonics and good food are usually advisable, as in all tertiary syphilitic affections.

TUBERCLE OF THE TONGUE

Tubercular ulceration of the tongue is comparatively rare, and is usually secondary to pulmonary phthisis but may be primary, the lungs being subsequently affected. It may be associated with tubercular infection of the submaxillary and cervical glands. The ulcers are usually present on the dorsum, but sometimes fissures and superficial indolent ulcers form at the tip and along the margins.

Tubercular ulcers are superficial, irregular in outline, and often stellate; they are very indolent, and show no tendency to spontaneous cure. The base is white and shreddy, and coated with thick, viscid, yellow mucus; the edges are infiltrated with tubercular matter but are not undermined, and there is no surrounding induration. Smaller ulcers or tubercular nodules are often seen surrounding the more pronounced lesions. The ulceration gradually increases in superficial area and in depth until it may be very extensive and occasion considerable pain and salivation. Tubercular ulcers may be diagnosed from syphilitic by their position and character, by the presence of other syphilitic or tubercular lesions, and by the effect of treatment. The age of the patient, the appearance of the ulcers, and the absence of induration serve to distinguish tubercular from cancerous ulceration. In doubtful cases microscopic examination should be resorted to with the view of detecting the tubercular nodules, and inoculation of a guinea-pig with the discharge may be tried.

Prognosis.—Tubercular ulceration of the tongue is a very serious condition associated as it is with laryngeal and pulmonary tuberculosis as a primary or secondary condition. These cases gradually take a downhill course and the patient dies in about a year or eighteen months.

Treatment.—If pulmonary phthisis is established, no active treatment is advisable. All sources of irritation should be avoided, and an unirritating mouth wash, such as is recommended in cases of superficial glossitis, should be used. Complete excision of the diseased area should be at once performed if the affection is primary. In any case if the local discomfort is great, the ulcers may be sharp-spooned, but there is danger of re-infection through the pulmonary expectoration.

Parenchymatous tubercular deposits are very rare and lead to the formation of chronic abscess. I recently had such a case under my care at the Westminster Hospital in a woman who was very extensively attacked by lupus. I removed the affected area by a V-shaped incision and united the margins. The wound healed without trouble.

MACROGLOSSIA—LYMPHANGIOMA

Etiology.—Macroglossia is a very rare condition; it affects the sexes equally and is usually congenital, but may also appear in connection with antecedent injury or inflammation, with mercurial salivation, and the acute specifics, especially scarlet fever and chicken-pox. It seems probable that all these conditions act by inducing lymphangitis and obstruction of the vessels.

Morbid anatomy and signs.—The enlargement of the tongue is similar in nature to that of tissues affected by elephantiasis, and is sometimes associated with cystic hygroma or enlargement of the cervical glands. It may affect part or all of the tongue. The primary change appears to be dependent on lymphatic obstruction; the vessels dilate behind and form cavernous spaces. Sometimes small lymphatic overgrowths like boiled sago-grains are seen on the mucous membrane. Following the lymphatic changes there is considerable increase in the connective tissue and round-celled infiltration of the mucous membrane, but the muscular substance is unaffected. At first the enlargement is slight and merely causes some thickness of speech with increased flow of saliva. As the case progresses, the tongue, marked by the teeth at the margins, protrudes from the mouth. In the worst cases the pendulous organ produces deformity of the jaws owing to the constant pressure; the teeth project outwards and may cut deeply into the under surface of the organ. The exposed surface is glazed and dry, and being constantly irritated may be the seat of ulcers and fissures. Repeated attacks of inflammation tend to aggravate the condition and give an impetus to the growth of the tongue. Salivation, dysphagia, and difficulty in mastication are proportional to the size of the organ. The enlargement is very gradual, but is usually slowly progressive, although it may remain stationary for a time.

Treatment.—Removal of a wedge-shaped portion of sufficient size is the best treatment. The edges should be carefully approximated by silkworm gut sutures and the mouth kept clean with Condy's fluid and iodoform. Healing readily occurs.

CYSTS OF THE TONGUE

Mucous cysts containing a clear viscid fluid are sometimes met with in the tongue. They are usually quite small, rounded, distinctly circumscribed, elastic, and painless. If they are large they stretch the mucous membrane over them, which becomes thinned, smooth, and shiny, and, in such cases, the cyst may be translucent. In the absence of translucency a mucous cyst may be mistaken for a solid tumour, a gumma, or a chronic abscess, the diagnosis being only made after puncture.

Treatment.—The cyst is usually easily dissected out, or may be freely laid open and plugged with a thin strip of gauze after the interior has been treated with zinc chloride (40 grs. ad ℥i.) to destroy the secreting surface. During healing, which is rapid, an antiseptic mouth wash should be occasionally used.

Parasitic cysts.—The **hydatid** is occasionally observed, and is diagnosed by puncture. The cyst should be opened and the wall removed.

Cysticercus cellulosæ has been recorded.

TUMOURS OF THE TONGUE

NON-MALIGNANT TUMOURS

Innocent tumours of the tongue, with the exception of papillomata, are rare. They grow in the substance of the organ, rarely attain a large size, only produce symptoms mechanically, cause no pain, and do not return after complete removal. They may be mistaken for chronic abscess, cyst, or gumma, the diagnosis being cleared up by antisyphilitic treatment, or, failing resolution by this means, by free incision of the mass.

Lipoma occurs at the anterior part near the edge of the tongue. It may last for many years without attaining a large size. The tumour may be lobulated, and if just beneath the mucous membrane its yellow colour may be distinguishable.

Fibroma closely resembles the lipoma, but has a greater predilection for the centre of the dorsum; it is not lobulated, and does not give any yellow appearance. These tumours may be multiple and grow very slowly.

Osteoma and chondroma have been occasionally met with, but are very rare.

Papilloma of the tongue is not uncommon. It usually forms on the dorsum near the margin in the anterior half of the tongue. The tumour is compound, and looks like the head of a cauliflower. It is broadly sessile, limited to the surface, and not indurated. If bitten or irritated a papilloma may ulcerate, and chronic irritation may lead to the development of epithelioma. Sometimes the diagnosis between papilloma and cancer is difficult, and must be at once decided by microscopic examination.

Papillomata are readily removed with the scissors, and the wound quickly heals.

Nævus.—Venous nævus of the tongue may occur on the surface of the mucous membrane or in the substance of the organ. In the former case the condition is precisely like the ordinary nævus of the skin; the growth is red, and may bleed freely.

The more deeply-seated nævi form a definite swelling, which can be diminished by squeezing, but quickly refills with blood when the pressure is withdrawn. The mucous membrane is bluish in colour, and dilated vessels may be seen coursing through it. Nævi of the tongue are congenital in origin, and are subject to the same changes as those occurring in the skin. Arterial nævus, or cirsoid aneurism, has been met with.

Treatment.—Nævi may usually be readily obliterated by the actual cautery. If a venous nævus is situated in the substance of the tongue the affected portion should be excised; free bleeding must be expected.

MALIGNANT TUMOURS

Sarcoma of the tongue is very rare, and may be mixed with glandular tissue.

In some cases these tumours are adeno-sarcomata, and probably originate in the gland of Blandin (p. 339). Sarcoma may or may not affect the lymphatic glands; the tumour is very malignant and recurrence soon occurs. The diagnosis may be very obscure; the tumour must be distinguished from other morbid growths, inflammatory collections, and from actinomycosis (p. 139, vol. i.). Treatment consists in removal of the tongue.

Cancer of the tongue—**Etiology.**—Squamous epithelioma (the only form of cancer met with in the tongue) is much more common in men than women, and usually occurs between forty and fifty-five years of age. The greater frequency with which the disease attacks men is certainly dependent upon the more numerous sources of lingual irritation in them, *e.g.* smoking, spirit-drinking, etc. The connection between cancer and smoking has been very much exaggerated. All those causes which have been shown to excite leucoma are also causes of cancer, and there is no doubt that in a large proportion of cases more than one source of irritation is responsible for the mischief. Leucoma is a common precursor of cancer, and the connection between the two is perhaps closer than has usually been supposed. Leucoma and fissures of the tongue are especially liable to become cancerous if they are continually irritated by the injudicious use of caustics or other means.

Morbid anatomy and signs.—Cancer is most commonly met with on the side of the anterior half of the tongue, but no part is exempt. It may originate in a patch of leucoma, in a persistent fissure or ulcer, at the base of an irritated wart, or as a hard indurated papule which speedily ulcerates. In whichever way it arises ulceration occurs early and gradually extends in depth and superficial area, while the epithelial elements invade the substance of the organ and cause considerable induration. The advancing growth may invade nearly the whole tongue, or may spread to the floor of the mouth, to the gums and jaws, or backwards to the fauces, palate, tonsils, and throat. The appearance presented by the cancer varies considerably in different cases. The ulcer may fungate beyond the surface (Fig. 115). The base is covered with unhealthy, flabby, and often sloughy granulations; the edges are everted, hard, and irregular, and the base distinctly indurated. In other cases, especially if the growth commenced in the base of a papilloma, the epithelium on the surface is hard and warty and ulceration does not occur so early, although the indurated extension into the tongue is evident. In these cases there may be doubts as to the malignant nature of the papilloma-

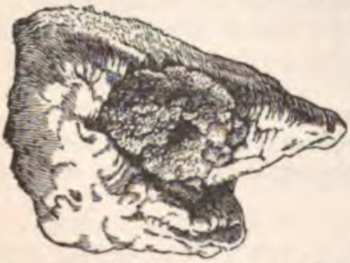
FIG. 115.—Epithelioma of the tongue, from a specimen in the Westminster Hospital Museum, No. 413A (drawn by C. H. Freeman).

like mass, and microscopic examination is imperative. Sometimes the ulcer is distinctly depressed and covered with a slough, somewhat resembling a gummatous excavation, but being very indurated and usually painful. The amount of ulceration varies very much; it may be the main feature present, or may be so slight that the patient thinks nothing of it, and comes for advice on account of the glandular involvement.

As the growth advances, especially if it involves the floor of the mouth, the movements of the tongue become more restricted and painful, and hence speech becomes thick and indistinct, mastication and deglutition difficult, and salivation very troublesome. The ulcerating foul mass in the mouth gives the breath a fœtid odour, and the decomposing matters are a source of danger and may excite septic bronchitis or pneumonia. Deep ulceration may erode the lingual artery and terminate the patient's sufferings by hæmorrhage. Pain varies much in its intensity. It may be practically absent, the patient perhaps only complaining of a sense of stiffness and some heat and burning when taking food. In other cases pain is very severe, and is much aggravated by movement of the tongue, especially if the ulcer rubs against the teeth. The pain radiates along the branches of the fifth nerve, and is especially felt over the temple and in the ear.

Within a few weeks from the first appearance of the disease the submaxillary lymphatic glands become enlarged, and subsequently the deep cervical set are implicated. No doubt the enlargement is caused, in addition to the cancerous growth, by sympathetic irritation, for if the tongue be removed and the glands left their size diminishes with the removal of local irritation. Although this fact is undoubted it ought never to influence the surgeon as regards removing the glands; if enlarged they must invariably be taken away. The glandular enlargement may be extreme, and as the disease advances the affected glands become matted together, and by their size may prevent the movements of the jaws and cause trouble by pressing on the pharynx and air-passages. The cancerous glands may break down, soften, and suppurate.

Secondary growths in internal organs are excessively rare.

Diagnosis.—As it is extremely important that an accurate diagnosis should be made at once, microscopic examination of a portion of the edge and deeper parts of the suspected mass should be immediately made in doubtful cases. When a doubt arises as to whether the disease may not be syphilitic, the microscope will clear up the diagnosis long before the use of anti-syphilitic remedies

Cancer of the tongue—Etiology.—Squamous epithelioma (the only form of cancer met with in the tongue) is much more common in men than women, and usually occurs between forty and fifty-five years of age. The greater frequency with which the disease attacks men is certainly dependent upon the more numerous sources of lingual irritation in them, *e.g.* smoking, spirit-drinking, etc. The connection between cancer and smoking has been very much exaggerated. All those causes which have been shown to excite leucoma are also causes of cancer, and there is no doubt that in a large proportion of cases more than one source of irritation is responsible for the mischief. Leucoma is a common precursor of cancer, and the connection between the two is perhaps closer than has usually been supposed. Leucoma and fissures of the tongue are especially liable to become cancerous if they are continually irritated by the injudicious use of caustics or other means.

Morbid anatomy and signs.—Cancer is most commonly met with on the side of the anterior half of the tongue, but no part is exempt. It may originate in a patch of leucoma, in a persistent fissure or ulcer, at the base of an irritated wart, or as a hard indurated papule which speedily ulcerates. In whichever way it arises ulceration occurs early and gradually extends in depth and superficial area, while the epithelial elements invade the substance of the organ and cause considerable induration. The advancing growth may invade nearly the whole tongue, or may spread to the floor of the mouth, to the gums and jaws, or backwards to the fauces, palate, tonsils, and throat. The appearance presented by the cancer varies considerably in different cases. The ulcer may fungate beyond the surface (Fig. 115). The base is covered with unhealthy, flabby, and often sloughy granulations; the edges are everted, hard, and irregular, and the base distinctly indurated. In other cases, especially if the growth commenced in the base of a papilloma, the epithelium on the surface is hard and warty and ulceration does not occur so early, although the indurated extension into the tongue is evident. In these cases there may be doubts as to the malignant nature of the papilloma-

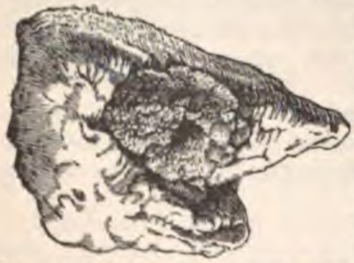

FIG. 115.—Epithelioma of the tongue, from a specimen in the Westminster Hospital Museum, No. 413A (drawn by C. H. Freeman).

like mass, and microscopic examination is imperative. Sometimes the ulcer is distinctly depressed and covered with a slough, somewhat resembling a gummatous excavation, but being very indurated and usually painful. The amount of ulceration varies very much; it may be the main feature present, or may be so slight that the patient thinks nothing of it, and comes for advice on account of the glandular involvement.

As the growth advances, especially if it involves the floor of the mouth, the movements of the tongue become more restricted and painful, and hence speech becomes thick and indistinct, mastication and deglutition difficult, and salivation very troublesome. The ulcerating foul mass in the mouth gives the breath a fœtid odour, and the decomposing matters are a source of danger and may excite septic bronchitis or pneumonia. Deep ulceration may erode the lingual artery and terminate the patient's sufferings by hæmorrhage. Pain varies much in its intensity. It may be practically absent, the patient perhaps only complaining of a sense of stiffness and some heat and burning when taking food. In other cases pain is very severe, and is much aggravated by movement of the tongue, especially if the ulcer rubs against the teeth. The pain radiates along the branches of the fifth nerve, and is especially felt over the temple and in the ear.

Within a few weeks from the first appearance of the disease the submaxillary lymphatic glands become enlarged, and subsequently the deep cervical set are implicated. No doubt the enlargement is caused, in addition to the cancerous growth, by sympathetic irritation, for if the tongue be removed and the glands left their size diminishes with the removal of local irritation. Although this fact is undoubted it ought never to influence the surgeon as regards removing the glands; if enlarged they must invariably be taken away. The glandular enlargement may be extreme, and as the disease advances the affected glands become matted together, and by their size may prevent the movements of the jaws and cause trouble by pressing on the pharynx and air-passages. The cancerous glands may break down, soften, and suppurate.

Secondary growths in internal organs are excessively rare.

Diagnosis.—As it is extremely important that an accurate diagnosis should be made at once, microscopic examination of a portion of the edge and deeper parts of the suspected mass should be immediately made in doubtful cases. When a doubt arises as to whether the disease may not be syphilitic, the microscope will clear up the diagnosis long before the use of anti-syphilitic remedies using the closed scissors as a director, to find the interval between these two muscles, for here will be found the lingual artery and vein; external to the hyoglossus is the hyoglossal nerve and another vein. As the genio-hyoglossus is divided, the artery will be seen to its outer side and may be easily secured, divided, and at once ligatured with silk or chromic gut. The muscles being divided far enough back, the surgeon completes the operation by snipping through the tongue transversely, opposite the hinder end of the median incision. During the operation, the throat must be kept clear of blood by sponging, but this should not be done more than necessary as it excites a considerable flow of mucus, which is very troublesome to the patient for some time afterwards. The operation being completed, the mouth is sponged dry and the raw surface covered with iodoform crystals.

With a little practice the operation is very easy and but little blood is lost. Sometimes the lingual is divided before it is seen and can be clamped; if the head is in the proper position the blood spurts out of the mouth and the vessel is readily secured, but if the head is too far back the blood strikes against the palate and fills the mouth, threatening to choke the patient. The bleeding can be at once arrested by passing the finger well behind the tongue and drawing it forwards against the hyoid bone, and the blood being sponged away no difficulty is experienced in seizing the vessel.

Excision of the whole tongue is performed in the same way. The tongue may be split down the middle and the two halves separately removed, or the mucous membrane being first divided all round the mouth the operation is completed as above described, the two linguals being sought for and ligatured. After removal of the whole tongue a thread should be passed through the stump and retained in position for a few days, so that if the stump tends to fall back within the grip of the fauces and threatens suffocation it can readily be drawn forwards. The thread is conveniently placed round the ear. Even in cases where the cancer does not affect the whole organ, but in which the other side is the seat of leucoma or fissures, it should be removed.

Splitting the cheek from the angle of the mouth backwards to the anterior border of the masseter is very useful if the disease extends far backwards and implicates the fauces. It adds but little to the gravity of the operation. The divided cheek should be accurately sutured with silkworm-gut and horsehair and covered with salicylic cotton and collodion.

After-treatment.—For the first few days the patient must be fed by means of a tube passed well behind the base of the tongue. The mouth should be kept free from mucus by gentle sponging and must be cleansed by frequent irrigation with Condy's fluid. Iodoform should be dusted over the surface, night and morning, and oftener if there is any fœtor of the breath.

The patient may be allowed to sit up in bed at the end of the first week, and may get up on the tenth day. After removal of the tongue the patient is more or less troubled by the difficulty of getting rid of his saliva. Speech is good, whether half or all the organ has been removed, but those letters for which the use of the tongue is essential are necessarily modified—thus the patient is unable to say T or D and usually substitutes P.

Kocher's operation beneath the jaw.—This operation is needed when the lateral portion of the floor of the mouth is involved and the glands in the inframaxillary space are diseased. Preliminary laryngotomy is sometimes advisable. An incision is made along the upper margin of the digastric muscle, terminating just below the lobe of the ear. The flap is raised, the facial and lingual arteries tied, all glands removed, and then the mouth is opened by dividing the mylohyoid muscle. The tongue and the affected part of the floor of the mouth is now drawn down through the wound by means of a thread passed through the tip, and it is divided far back and removed. If the whole tongue is to be removed the opposite lingual artery should be first ligatured. The wound is united and drained at the most dependent part, and is best plugged through the mouth with iodoform gauze for a few days.

Division of the symphysis (Syme's operation), or removal of the anterior portion of the jaw is needed when the adjacent part of the floor of the mouth is diseased and if the growth has invaded the gums and bone. A preliminary laryngotomy is recommended by some, but I have never found it necessary; it, moreover, adds to the danger of an already formidable operation. The incision is made in the middle line, through the lip and chin down to the level of the hyoid bone. One of the central incisor teeth is extracted, and the jaw is sawn and, if necessary, a portion is removed and the tongue and floor of the mouth are cut away with scissors. The jaw may be wired if it has been simply cut through, and the skin incision should be accurately united, except at the lower part where a drainage tube is inserted.

The after-treatment is that already described.

Palliative treatment of cancer of the tongue.—In cases which are so far advanced that no operation can be undertaken with the view of curing the disease, much may be done to alleviate the patient's sufferings and render his last days more comfortable. If the presence of the cancerous mass in the mouth is itself a cause of trouble producing great pain, salivation, and fœtor of the breath and preventing the patient taking food, it may advantageously be removed. I have on several occasions done this when the mass of glands in the neck could not be operated on, and the operation has certainly given the patient great ease. But it sometimes happens that the main stress of the disease falls upon the lymphatic glands, and that the condition of the tongue is such that with a little ordinary care it does not cause much trouble. The mouth should be kept quite clean by the frequent use of Condy's fluid, Listerine, or a solution of quinine, and the raw surface dusted with iodoform twice a day. Cleanliness not only materially diminishes the pain but also the risk of septic bronchitis or pneumonia. If the pain is great, all the teeth against which the cancerous mass rubs should be extracted. The relief is immediate and often very striking. Failing this, the patient should be allowed sufficient opium to dull the pain; no restraint need be felt in this matter, for as the patient is doomed there is no object in withholding the drug. Division of the lingual nerve may also be practised for the relief of pain, and it also tends to lessen the secretion of saliva; the nerve can easily be divided with a curved, sharp-pointed bistoury as it winds round the jaw below the last molar tooth; if the tongue is well drawn out of the mouth to the opposite side the nerve can be more easily reached.

Ligature of the lingual may be necessary to control hæmorrhage. Tracheotomy is but rarely necessary. In one case, I was driven to perform gastrostomy, as the cancer spread to the pharynx and produced such pain that the patient was quite unable to take food of any kind.

DISEASES OF THE SALIVARY GLANDS[1]

PAROTITIS—MUMPS

Mumps is an acute infective disease with an incubation of about three weeks. It chiefly attacks children, but may be met with in later life. The disease is usually bilateral, affecting the sides consecutively; it may also affect the submaxillary glands, the testes, ovaries, and breasts.

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[1] For "Salivary Fistula," see p. 284, vol. ii.

Parotitis may also follow one of the acute specific diseases or may occur during its height; in the latter case, suppuration is not infrequent and the prognosis to life is grave. The micro-organisms exciting parotitis probably find their way along the duct, and this explains why the socia parotidis may be the first part of the gland to suffer. Parotitis is occasionally met with as a complication of injury or disease of the abdominal or pelvic viscera, but the connection between the conditions is quite unknown, although it appears to be more than accidental.

Symptoms.—The acuteness of the onset depends in great measure upon the actual cause of the inflammation. In mumps, the patient may complain of general malaise and some sense of stiffness about the lower jaw for a few days before the nature of the disease is fully declared. The temperature rises perhaps to 103° or 104° F., the parotid region is much swollen and acutely tender, and tensive, aching pain radiates to the ear, up the head, and along the jaw. The mouth cannot be opened, and any attempt to do so materially increases the pain. Suppuration is rare, but should it occur, the local and general signs are more severe and the patient may have shivering fits or a definite rigor; the skin becomes implicated and the abscess points locally, or the pus, guided by the deep fascia, may burrow down the neck. When secondary inflammation of the testes occurs it usually does so as the parotid inflammation subsides; it is very likely to be followed by atrophy, and if both organs be affected, by sterility (see p. 614).

Treatment.—But little treatment beyond rest, warmth to the parotid region, and fluid food is necessary. The acute stage usually subsides at the end of a week. If suppuration occurs, the pus must be early evacuated by an incision made parallel to the duct and branches of the facial nerve so that these be not wounded. Secondary epididymitis must be treated as described at p. 614.

Inflammation of the submaxillary gland.—This may be associated with mumps or, in a very mild form, may be due to a calculus in the duct. It must not be confounded with inflammation of the submaxillary lymphatic glands which may be dependent on carious teeth or some form of stomatitis. The treatment is similar to that of parotitis.

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SALIVARY CALCULUS

Concretions composed of calcium phosphate and carbonate sometimes found in Wharton's duct, very rarely in Steno's. Th calculi may be of considerable size and are shaped like a d stone; they usually lodge near the orifice of the duct and may felt close to the frenum linguæ in the floor of the mouth. patient's attention is usually drawn to his mouth by the occurre of pain and swelling of the submaxillary gland in consequenc the impediment offered to the escape of saliva from the duct. will probably have noticed that the glandular swelling is increa at meal times, owing to the increased secretion of saliva. examination, the hard calculus is easily detected, although patient may be quite unaware of its presence, referring all trouble to the gland itself.

Occasionally the stone excites suppuration in the floor of mouth.

Treatment.—The calculus must be removed by an incis through the mucous membrane of the floor of the mouth and wall of the duct, and care should be taken to remove it wh The finger should be passed along the line of the duct from beh forwards to make sure that no concretion is left behind.

TUMOURS OF THE SALIVARY GLANDS

Tumours originating primarily in the salivary glands are r and are almost confined to the parotid. Cancer of the floor of mouth may spread to the submaxillary or sublingual glands. Cy originating in the ducts are described at p. 333.

The ordinary parotid tumour is a composite new growth, co posed of gland tissue and fibrous stroma (*adeno-fibroma*), mi with embryonic cartilage and sarcoma (*chondro-sarcoma*) epithelial pearls. Such tumours often undergo extensive my matous degeneration and may contain large mucous cysts. Sim tumours are met with in the pancreas and testicle (see p. 634). growth is encapsuled and its rate of growth may be slow or ra according to the amount of sarcomatous tissue present; and u this depends its innocence or malignancy. It may attain enormous size and reach far down the neck.

The tumour is usually dense but elastic, irregular, and lobula on the surface; it displaces the surrounding parts, growing on the face, beneath the ramus of the jaw, and downwards and ba wards into the neck. In malignant tumours the facial nerve may be implicated, but is very rarely completely paralysed.

Small tumours must not be mistaken for sebaceous cysts or enlargement of the lymphatic gland lying on the masseter close to the anterior border of the parotid.

Treatment.—If small the growth may be removed by an incision running parallel with the facial nerve and Steno's duct. When the incision has been made the mass should be examined to see if any branches of the facial nerve are implicated, and these must be carefully preserved, unless such preservation would necessitate leaving some of the growth behind. Large tumours of the parotid are very difficult and dangerous of removal, as will be evident when the important structures in connection with the gland are called to mind.

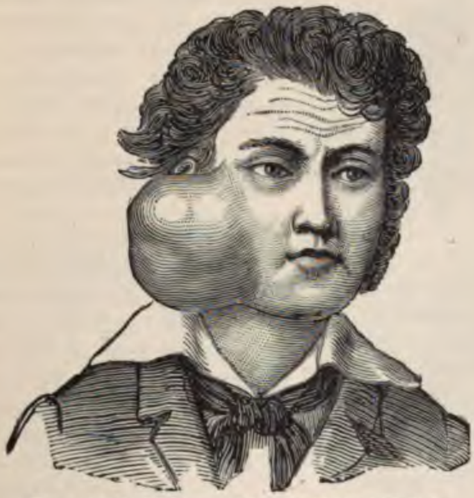

FIG. 116.—Enchondroma of the parotid gland (Follin).

CHAPTER XVII

DISEASES OF THE ŒSOPHAGUS

Anatomy.—The œsophagus is about ten inches in length,
extends from the level of the cricoid cartilage to the ston
passing through the diaphragm opposite the ninth dorsal vert
Its narrowest point is behind the cricoid; it is also constricted
passes through the diaphragm. In the neck it lies on the
behind the trachea and deviates a little to the left; the recu
laryngeal nerve lies on each side in the groove between the tra
and œsophagus. Laterally are the lobe of the thyroid body, ca
artery, and internal jugular vein. In the thorax the bifurcati
the trachea, left bronchus, and pericardium are anterior; on th
is the aorta and left pleura; on the right the vena azygos major
right pleura. The vagus nerves lie one on each side and form
plexus gulæ over the tube. Near the diaphragm the gullet li
front of the aorta.

The wall is formed from without in by (1) longitudinal mus
fibres; (2) circular muscular fibres; (3) submucous coat; an
mucous membrane. The epithelium is squamous and strat
and passes abruptly into the columnar variety at the stomach.
mucous compound racemose glands lie in the submucous coat,
the inner surface is beset by fine papillæ.

DILATATION AND SACCULATION

Dilatation of the œsophagus may occur above a strictur
it may be of congenital origin. Dilatation dependent on stri
is secondary to compensatory hypertrophy, and consequently
muscular walls are increased in thickness, but the mucous memb

may be ulcerated from the irritation of retained food, and as the ulceration extends in death rupture may be occasioned if a bougie is passed.

Sacculation is congenital or acquired, the nature of the sacculus and the effects it produces varying in the two cases.

Congenital sacculation—Pressure pouches.—Pressure diverticula are always situated posteriorly, and pass downwards and to the left between the œsophagus and vertebræ. They are nearly always met with in men about middle life, although it is pretty certain that they owe their origin to some congenital anomaly, the pouch being gradually distended until of sufficient size to cause symptoms. Pressure pouches are formed of mucous membrane herniated through the muscular coats, and they spring from the junction of the œsophagus and pharynx, or from the lower end of the latter (*pharyngocele*). A pouch may attain a large size, being gradually enlarged by pressure of the food within. If small, it produces no symptoms, but if large there are signs of dysphagia, due to the pressure of the pouch (which is filled with undigested food) on the œsophagus. The pouch may sometimes be partially emptied spontaneously, or the contents may be pushed into the pharynx by squeezing the swelling, the material thus obtained will be found to be alkaline, and not acid as would be the case if it came from the stomach. The partial emptying of the diverticulum may enable the patient to perform imperfect rumination; or he may periodically vomit undigested and putrid food, a sign of great diagnostic importance. When large the pouch may extend a long way down and form a distinct prominence in the neck. The symptoms simulating stricture may lead the surgeon to pass a bougie, and the similarity

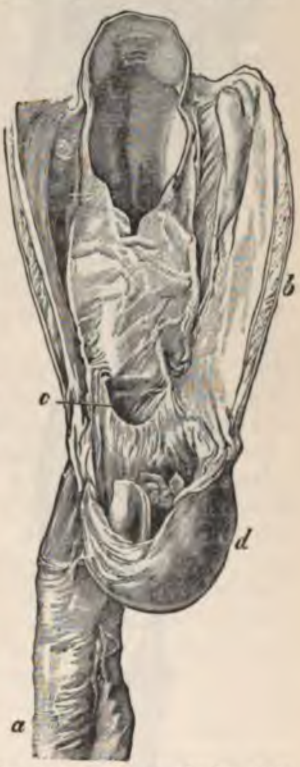

FIG. 117.—Pressure diverticulum of the pharynx at its junction with the œsophagus (Ziegler). *a*, œsophagus; *b*, pharynx; *c*, opening into œsophagus; *d*, diverticulum containing a plum-stone.

may be further increased should the instrument pass into the pouch instead of going down the gullet.

Treatment.—If the sacculus causes much trouble it should be excised through a long œsophagotomy incision; the wall of the gullet is carefully closed with silk sutures which should not include the mucous membrane, and the wound in the neck must be left open. Feeding should be conducted by enemata or through a tube passed down the œsophagus, and retained in position for a few days.

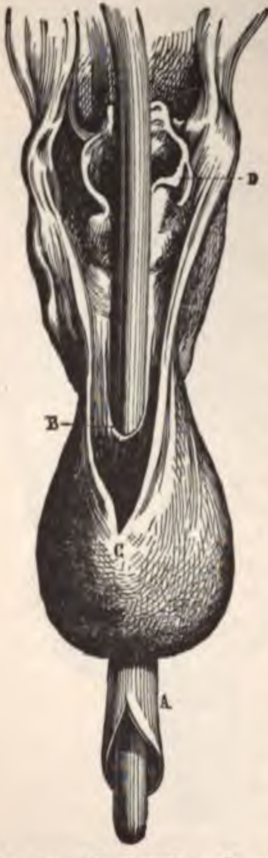

FIG. 118.—Œsophageal pouch. *A*, œsophagus, along which a sound is passed (*B*); *C*, the pouch; *D*, aperture of the larynx (Follin).

Traction sacculi are always small, and are usually situated near the bifurcation of the trachea. They do not excite symptoms, and are only discovered after death. Traction sacculi are due to inflammatory adhesions between the gullet wall and some external part, *e.g.* lymphatic glands; cicatricial contraction thus leads to the adherent portion being drawn outwards into a small funnel-shaped diverticulum.

INFLAMMATION OF THE ŒSOPHAGUS

Acute inflammation is very rare, except as the result of swallowing some corrosive fluid. Its causes are unknown. There is acute and severe pain, thirst, vomiting, and perhaps hæmatemesis. Ulceration and perforation may occur. The treatment consists in complete rest of the gullet and feeding by enemata. Chronic inflammation and ulceration may result from syphilis or tubercle, but is extremely rare; cicatricial stricture may follow.

Localised inflammation and ulceration may result from the impaction of a foreign body.

STRICTURE OF THE ŒSOPHAGUS

Simple fibrous stricture is caused by contraction following ulceration, which may be due (1) to injury; (2) to the action of corrosive poisons; (3) to the lodgment of a foreign body; or (4) to syphilis, the first two being the most common. Congenital stricture of the commencement of the tube is occasionally met with. Fibrous stricture is rare; it is usually situated at the upper end of the gullet, and may involve two or three inches; the degree of tightness varies considerably. The symptoms are those met with in cases of malignant stricture, but they extend over a longer period of time, and there may be a distinct history of injury. Treatment consists in gradual dilatation by the passage of bougies, or the introduction of a Symonds's tube, and in severe cases the performance of gastrostomy may be necessary.

Malignant stricture is more common in males than females, and may occur at any part of the tube, but is most usual in the upper third, opposite the bifurcation of the trachea, or at the cardiac end.

The growth is nearly always a squamous epithelioma, but the columnar form may be met with at the lower end, if the growth originates at the junction of stomach and œsophagus and spreads upwards to the latter. Scirrhus has occasionally been met with. The cancer invades the whole calibre of the tube and usually involves about two inches of its length. The margins are everted and the surface ulcerated and indurated. As growth proceeds the cancer invades the glands and neighbouring parts, especially eroding and sprouting into the trachea; it may also invade the mediastinum, pleura, and lung, and if the œsophagus gives way the food escapes and sets up fatal inflammation. In all cases of stricture of the œsophagus the tube above the disease hypertrophies in response to the increased need for muscular power, compensation failing dilatation ensues; the food, arrested above the stricture, may excite ulceration of the mucous membrane, and should this extend deeply, rupture of the tube may result.

Symptoms of œsophageal obstruction.—Gradually increasing dysphagia is the leading feature; at first the patient swallows ordinary food with pain and difficulty, but very soon can only take it in small quantities at a time and after prolonged mastication, later on fluids only can be swallowed, and finally nothing will pass. The patient will often clearly indicate the position of the stricture by feeling the bolus of food arrested at its seat. Regurgitation of food usually occurs within a few minutes of attempting to swallow, but if the stricture is low down it may not return for some time. In cancerous cases blood and mucus may be brought up. Auscultation in the interscapular region may detect the point of arrest of the food, but this sign is of little value. There is more or less pain, which radiates over the chest, but the patient can usually accurately locate with his finger the point of maximum intensity, *i.e.* the seat of the stricture. The voice is sometimes altered, and the patient has a short brassy cough, and occasionally laryngeal spasm due either to direct involvement of the trachea or to irritation of the recurrent laryngeal nerve. Owing to the inability to take sufficient nourishment the health and strength rapidly decline. Cancer of the cervical portion of the gullet may cause a definite tumour and enlargement of the glands, which may be readily detected by examination of the neck.

The passage of an œsophageal bougie will determine the fact of stricture, its situation and degree, but in all cases before this is undertaken the chest must be carefully examined for aneurism, for should such be present and be responsible for the symptoms by causing pressure on the gullet, the passage of a bougie is interdicted as it might rupture the sac and cause instant death. The patient should sit in an arm-chair and slightly flex the neck; the surgeon standing in front passes the bougie (previously rendered supple by immersion in hot water, and covered with glycerine) well to the back of the pharynx, and guiding it past the larynx with his finger gradually pushes it down the gullet. The first stage often causes much distress, coughing, and choking, but as soon as the larynx is passed this in great measure subsides. The passage of the instrument is occasionally facilitated if the patient swallows as it is pushed onwards. If the tube is arrested gentle pressure should be employed, as the stoppage may be due to temporary spasm of the muscular coat, but if it is evidently due to the presence of stricture no attempt should be made to force the bougie through, but a smaller one should be used to ascertain the degree of constriction. If a pressure sacculus is present the tube may pass into it, and being there arrested the surgeon may be led to suspect stricture where none exists. An œsophagus bougie may be considered to have entered the stomach when about sixteen inches have passed the teeth, but this measurement is of course liable to considerable variation.

Treatment of stricture.—The diet must be carefully selected, and should chiefly consist of finely minced or pounded meat or fish, eggs, soup, broths, artificial foods, and milk which may have powdered biscuit, etc. mixed with it. In cases of simple stricture the passage of bougies may cause gradual dilatation, but in cancerous cases this should not be done since it causes considerable pain, is not free from danger, and does not produce any permanent good.

When even the most easily swallowed food is taken with difficulty, a Symonds's tube may be introduced through the stricture, the threads passed through its upper funnel-shaped end being brought out of the mouth or fixed to the teeth; the tube should be removed about every two weeks, cleaned, and replaced. Symonds's tube is usually borne with comfort, the patient being practically ignorant of its presence; occasionally it causes much pain and annoyance. When a stricture is so tight that fluids only can be taken gastrostomy should be performed; the operation is fully discussed at p. 384.

It is doubtful if an attempt to remove an organic stricture in the cervical portion by œsophagectomy is ever justifiable.

SPASM OF THE ŒSOPHAGUS—HYSTERICAL STRICTURE

This condition, superficially simulating organic stricture, is usually met with in hysterical females under thirty years of age, but may also be found in males and advanced life. The symptoms are dysphagia, regurgitation of food, and sometimes pain; they vary in degree from time to time and are invariably made worse if attention be drawn to their presence; at times the patient swallows without difficulty. The globus hystericus is not infrequently present. The passage of a bougie will show that there is no narrowing of the tube, but it may excite temporary spasm, which, however, soon yields to gentle pressure.

The treatment consists in the occasional passage of a bougie combined with anti-spasmodic drugs. If the condition is persistent, the mucous membrane may be treated with a solution of nitrate of silver applied by means of a sponge probang. Spasm of the œsophagus is a prominent symptom in rabies.

COMPRESSION OF THE ŒSOPHAGUS FROM WITHOUT

Symptoms of stricture may be induced by compression of the œsophagus by mediastinal tumours. The most usual of these is a thoracic aneurism, and until the presence of such has been negatived no bougie should be passed, or the sac, if present, may be ruptured. Mediastinal sarcomata, enlarged glands, goître, etc. may also give rise to dysphagia.

INNOCENT TUMOURS OF THE ŒSOPHAGUS

Innocent tumours are rare; they never attain a large size and rarely produce symptoms. **Fibromata** and **papillomata** are the most usual; **lipoma, myxoma, myoma,** and **sarcoma** have been recorded. If symptoms are produced they are those of obstruction, and require the ordinary treatment. An innocent tumour situated in the cervical region might be removed by œsophagotomy.

ŒSOPHAGOTOMY

This operation is performed for the removal of foreign bodies impacted in the upper part of the gullet. An incision is made just in front of the anterior edge of the left sterno-mastoid muscle extending from the upper border of the thyroid cartilage down to about three-quarters of an inch above the clavicle. The muscle is drawn aside, and the situation of the vessels having been determined by the finger, they are gently hooked outwards and the trachea is drawn inwards, care being taken that the inferior thyroid artery and recurrent laryngeal nerve which run in the groove between the trachea and gullet are not wounded. The situation of the œsophagus is usually recognised by the presence of the foreign body within it, but if not, a bougie should be passed through the mouth. The tube is incised longitudinally to a sufficient extent, the foreign body is removed, and the wound closed with fine silk or chromic gut sutures passed only through the muscular coats. When the gullet wall is ulcerated, or sloughing, no attempt is to be made to suture the wound. The superficial wound should always be left open and free drainage provided, as septic material often escapes when the gullet is opened, and may excite fatal cellulitis. For the first four or five days the patient should be fed by enemata; but if he is much exhausted, a soft feeding tube should be passed through the mouth to the stomach and left in position.

Œsophagotomy, or opening the tube below a stricture for purposes of feeding, and **œsophagectomy** for the removal of cancerous disease are operations which prudent surgeons have practically abandoned.

CHAPTER XVIII

SURGICAL DISEASES OF THE ABDOMINAL VISCERA[1]

THE SURGERY OF THE LIVER

HEPATIC ABSCESS

Causes.—The great majority of cases of abscess of the liver are of dysenteric origin (*hepatic dysentery*), and occur in men more often than in women, and in Europeans rather than natives. Tropical abscess is no doubt predisposed to by neglect of the ordinary rules of health, indulgence in alcohol, slight injury or exposure to cold. Abscess of the liver in the minority of cases may arise as a direct result of traumatism, from ulceration and rupture of a bile duct, or from suppuration of a hydatid cyst, the last being probably the most common cause of abscess which originates in persons not living in the Tropics.

Morbid anatomy.—Tropical abscess is usually single and situate in the posterior part of the right lobe. It may contain pints of pus limited by a more or less definite wall, the cavity being often traversed by bridles of tissue dividing it into loculi. The loculi frequently represent adjacent areas of suppuration which have fused. The inner surface of the wall is covered with slimy pus, which is usually thick, tenacious, and of a chocolate-brown colour; it may be stained by altered blood- or bile-pigment owing to extravasation from the vessels or ducts. Pieces of necrosed liver substance are sometimes found floating free in the pus; it also contains a motile organism—the *amœba coli* which is probably the determining cause of suppuration.

As the abscess increases in size the liver cells become compressed and atrophied. Glisson's capsule and the peritoneum are thickened and adhesions may form with the parietes or some neighbouring structure. Hepatic abscess may burst into the right lung, the colon, or duodenum; more rarely into the stomach, general peritoneal cavity, or externally; most rarely of all into the gall-bladder, pelvis of the kidney, or inferior cava. Sometimes a liver abscess burrows along the colon into the pelvis. The effect of rupture naturally depends upon its seat; very rarely the sac closes by granulation; more usually the patient, unless relieved by surgery, is worn out by prolonged suppuration and hectic and dies.

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[1] The surgery of the genito-urinary organs is not included.

Symptoms.—The onset is usually insidious, and very often the abscess attains a large size before its discovery. There is uneasiness in the hepatic region, pain referred to the angle of the scapula, indigestion, general malaise, and failing health.

Chills and rigors are sometimes present, and there is usually a nocturnal rise of temperature of two or three degrees, accompanied by profuse sweating. The skin is usually sallow, but jaundice is rare. In dysenteric cases there may be present evidence, or at least a history, of that disease.

Physical examination shows that the liver is enlarged, usually in an upward direction; the intercostal spaces are flattened and may be bulged, and if the lung is much compressed there will be difficulty in breathing with slight cough. If the abscess discharges into the lung, there will be expectoration of the characteristically coloured pus. Difficulty is often experienced in diagnosing between hepatic abscess and basic empyema; the history of the case, and the fact that in the former the upper limit of the dulness is arched corresponding to the dome of the diaphragm must be chiefly relied upon. If there is any doubt as to the diagnosis, a fine aspirating needle should be used. Dr. Patrick Manson recommends that in the absence of definite localising signs the needle should be thrust through the seventh or eighth space in the anterior axillary line; if no pus is found the puncture should be repeated below the costal margin, just inside the nipple line, and failing this, in a line with the angle of the scapula.

Treatment.—As soon as the abscess is diagnosed it should be opened and freely drained, the position of the incision varying with the seat of the pus. The opening must be free enough to enable the surgeon to thoroughly explore the cavity with a view to making counter-openings if necessary. A full-sized drainage tube should be used and the cavity kept thoroughly clean by flushing with sterilised water. If after the operation the patient's condition does not rapidly improve, or if it partially improves and then remains stationary, the surgeon should again explore the cavity, to ascertain if the drainage is efficient, or if a second abscess cavity is present. When the incision is made it may be found that the liver is not adherent to the surface; if this be so, the operation may be performed in two stages, the organ being stitched to the parietes, or the external wound plugged with gauze, as is most convenient; the abscess may be opened in four or five days, when the liver will be found adherent to the parietes. If it is determined, owing to the urgency of the symptoms, to open the abscess at once, sponges should be packed round it to shut off the peritoneal cavity, and after the pus has escaped the abscess wall must be united to the skin by a few points of suture. If the liver substance has to be cut through, the bleeding is profuse, but is readily arrested by sponge pressure. When the abscess encroaches on the pleural cavity this is usually obliterated, and portions of the lower ribs may be removed if necessary; if the pleural cavity is not obliterated the two layers of pleura should be sutured and the abscess opened in two or three days. The healing process is tedious owing to the want of full contraction, and a persistent sinus may result necessitating further treatment.

HYDATIDS OF THE LIVER

Morbid anatomy.—Hydatid cyst is more common in the liver than in any other part of the body, and is usually situated in the right lobe. The cysticercus (the embryo of *tænia echinococcus*—a tape-worm found in dogs and sheep) enters the alimentary canal, is taken up by the blood stream, and where it lodges produces the hydatid cyst. The cyst consists of a true parasitic, enclosed in an adventitious or false cyst wall formed of fibrous tissue resulting from chronic irritation. The true cyst wall, which collapses and curls up when removed, is gelatinous in appearance and composed of seven or eight layers and a delicate inner layer; this lamination is characteristic. The true cyst is easily lacerable and readily separates from the adventitious wall, which may be very dense or even calcareous. Hydatids contain a clear, watery fluid, sp. gr. 1010, in which sodium chloride is present. The cyst may be "barren," but more usually the inner surface is studded with brood-capsules containing clusters of minute scolices armed with hooklets which, when the fluid is withdrawn, separate from the wall and are seen floating in it as minute white specks. The scolices may further develop-

and thus daughter cysts be formed; from these a third generation may arise in like manner. Accumulated daughter cysts may fill the parent tumour, which then presents a foliaceous appearance, and the contents may become caseous. Sometimes a cyst is loculated and the loculi may extend in different directions.

A hydatid cyst, continuing to grow slowly for many years, may attain an enormous size; in rare cases it undergoes spontaneous cure and shrivels up, but more usually ruptures or suppurates. Rupture may occur in the same directions in which an abscess may burst (see p. 368).

Signs and symptoms.—The symptoms of hydatid cyst are simply the result of mechanical pressure, unless rupture or suppuration should occur. In the latter case the symptoms are identical with those described under hepatic abscess. A small cyst may remain undetected; but if it is large, and especially is so situated that it readily induces pressure symptoms, its detection is easy. The liver is enlarged and usually displaced downwards. This enlargement affects only that part of the liver in which the cyst is situated, and hence is usually classed with the irregular enlargements of the liver. The cyst, if projecting on the surface, forms a smooth, painless, globular, elastic swelling which may distinctly fluctuate, or may, when percussed, give rise to a peculiar thrill (*hydatid fremitus*). The tumour usually presents in the epigastric or hypochondriac region, but if the cyst is in the posterior surface of the right lobe, its presence is not so easily detected. Very large cysts may cause weight and discomfort in the hepatic region, a sense of abdominal fulness, and sometimes dyspeptic symptoms. If the tumour encroaches on the thorax, the respirations may be impeded from pressure on the lung and interference with the contraction of the diaphragm. Rupture of a hydatid into the peritoneal or pleural cavity nearly always excites acute inflammation which may speedily kill.

Treatment.—Puncture or aspiration of a hyatid cyst may be carefully performed for diagnostic purposes, but not as a remedial measure; for it not only fails to cure in the great bulk of cases, but also lays the patient open to the risk of fatal peritonitis occasioned by leakage of the fluid. A hydatid cyst should be treated in the same manner as abscess (p. 368), the daughter cysts and parasitic cyst wall being completely removed and a large drainage tube inserted. It is occasionally possible to completely enucleate the tumour, and if so, this should be done. During the healing stage the patient's strength must be kept up and every care taken that the unavoidable suppuration does not impair his health. The strictest antiseptic precautions are necessary.

THE SURGERY OF THE GALL-BLADDER

GALL-STONES AND THEIR EFFECTS

Gall-stones are more common in women than men, increasing in frequency with every decade after thirty years of age. They vary in number, size, composition, and consistency.

Composition.—Most calculi consist of cholesterine, bile-pigment, and a small quantity of salts; stones of pure cholesterine or pure bile-pigment are not uncommon, but those composed of pure carbonate of lime are exceedingly rare.

Effects and symptoms.—Gall-stones may lead to one or other of the following conditions:—

(1) In the majority of cases they remain in the gall-bladder and cause no inconvenience. Increasing in size and number they may completely fill the cavity, the walls of which, thickened by chronic inflammation, contract on and encapsule the calculi. Under such circumstances the gall-bladder is rendered functionless, and there are usually no symptoms; but occasionally attacks of pain, unaccompanied by jaundice, but in other respects indistinguishable from ordinary hepatic colic, demand the performance of some operation—preferably cholecystectomy. Mayo Robson considers that these attacks are occasioned by the adhesions so often found round the gall-bladder.

(2) Hepatic colic is due to the passage of a stone along the cystic and common ducts. The patient is suddenly seized with severe and agonising pain in the situation of the gall-bladder, radiating towards the umbilicus. The pain is continuous, with paroxysmal exacerbations; it induces more or less collapse, which may be directly fatal, or the attack may be accompanied by a rigor and rise of temperature such as is seen in ague. Nausea and vomiting are prominent symptoms, and jaundice usually quickly supervenes, but soon subsides when the stone has passed. Jaundice may, however, be quite absent. Hepatic colic terminates as quickly as it arises, the duration of the attack being usually counted by hours, but sometimes by days; in the latter case the symptoms may temporarily subside for some hours. If many stones are present, repeated attacks of colic, accompanied by increasing jaundice, but perhaps less pain, may occur; or the same stone, having failed to

pass the cystic duct, falls again into the gall-bladder, and may be the cause of further attacks; this should be suspected if, after repeated attacks, no gall-stones have been discovered in the excreta. Repeated attacks of hepatic colic are accompanied by the formation of adhesions between the gall-bladder and surrounding parts. Between the attacks of colic the patient may be quite well and free from pain or jaundice, but sometimes complains of dyspeptic symptoms with a feeling of uneasiness and fulness in the region of the gall-bladder.

(3) Impaction in the cystic duct. A stone which has, during an attack of colic, engaged in the cystic or common duct may become impacted. If a stone impacts in the cystic duct or neck of the gall-bladder the sac dilates behind it and becomes filled with a clear glairy mucus, like unboiled white of egg; the distension may be enormous, producing a large cystic tumour which may eventually suppurate or rupture. At the time of impaction in the cystic duct the patient is seized with hepatic colic, the pain, however, passes off or becomes less marked, but persistent; jaundice is not usually present since the common duct is unaffected. When the gall-bladder is distended it forms a tumour enlarging downwards in a line from the tenth costal cartilage to a point midway between the umbilicus and pubes. Such a tumour may be very large and has been mistaken for a hydatid cyst, a renal, or other abdominal tumour. Impaction in the cystic duct must be treated by cholecystotomy combined with cholelithotrity.

(4) Impaction in the common duct is a very grave condition. At the time of impaction there are the signs of hepatic colic, the pain being so severe that fatal collapse may ensue; jaundice quickly supervenes, and is persistent and deep. If the impaction be complete, death will soon occur unless the stone be removed; if it be incomplete, hydrops or empyema of the gall-bladder will complicate the case. Sometimes the jaundice progressively deepens, a condition very suggestive of associated cancer of the liver, which is by no means uncommon. In rare cases an impacted stone ulcerates through the wall of the duct, exciting local suppuration or general peritonitis, according to whether adhesions are present or not. Impaction in the common duct must be treated by removal of the stone.

(5) It sometimes happens that the gall-bladder becomes adherent to the duodenum, more rarely to the colon, and a fistulous opening is established between the two, through which the contents of the gall-bladder pass into the gut. If a large stone is thus voided it

may pass *per anum* or may give rise to intestinal obstruction (see p. 419). The symptoms attending the formation of such a communication are very ill-defined; they are, indeed, in many cases so slight that the occurrence is entirely unsuspected.

(6) Empyema of the gall-bladder. The chronic irritation of calculi within it, or their impaction in the cystic or common duct, may occasion empyema of the gall-bladder. In such cases a tumour is formed which enlarges downwards towards the middle line, and there is considerable pain and tenderness and some elevation of temperature. This condition necessitates the performance of cholecystotomy.

Treatment of gall-stones—Treatment of hepatic colic.—During the paroxysm steps must be taken to alleviate the agonising pain by hypodermic injection of morphia with the local employment of hot fomentations. If this does not alleviate the pain the patient must be placed under the influence of chloroform, which should not be pushed to deep anæsthesia. For some days subsequently the fæces should be broken up and examined with the view of detecting the stone.

Treatment by operation.—Mr. Mayo Robson gives the following conditions as indications of the necessity for surgical interference:—

(1) Repeated attacks of hepatic colic undermining the general health.

(2) Impaction in the cystic duct with distension of the gall-bladder.

(3) Impaction in the common duct.

(4) Empyema of the gall-bladder.

(5) Evidence of suppuration in the neighbourhood of the gall-bladder or of perforation.

OPERATIONS ON THE GALL-BLADDER

Aspiration of a distended gall-bladder is not free from danger, and is at the best merely palliative. It should only be resorted to during the performance of some radical operation when the size of the gall-bladder is a bar to the necessary manipulation after the abdomen has been opened.

Cholecystotomy may be required for the evacuation of stones or for distension or empyema of the gall-bladder. The operation under ordinary circumstances is comparatively safe if carefully performed; the danger is greater if jaundice is present, and greater still if the liver is cancerous. Cholecystotomy should, if possible, be performed in two stages.

The abdomen is opened in the right linea semilunaris or over the most prominent part of the tumour, if such be present. The ducts must now be examined, the gall-bladder being first aspirated if its size impedes manipulation. If the ducts are found to be free, the gall-bladder is well drawn up into the wound, and its muscular and peritoneal coats are united to the parietal peritoneum and fascia by silk sutures one-eighth of an inch apart; an antiseptic dressing is applied and the second stage of the operation completed on the fourth or fifth day. If the skin is included in the sutures subsequent permanent fistula is much more likely to result. If it is decided to complete the operation in one stage (as will be necessary if it is undertaken for impacted stone), the gall-bladder is well drawn up into the wound and the abdominal cavity shut off by sponges. It is thereupon incised and its contents evacuated, the edges of the opening are stitched to the fascia and peritoneum, and a drainage tube is inserted.

If, however, the ducts are found to contain a stone, this must be removed by one of the following methods:—

(*a*) When possible it should be extracted through the incision in the gall-bladder by forceps, and, if necessary, it may be gradually chipped away in small fragments. When a gall-stone is broken up before removal the operation is sometimes spoken of as a cholelithotrity.

(*b*) If the above fails, an attempt should be made to crush the stone by seizing the duct with well-padded forceps which are gradually tightened, the force employed being carefully regulated, so that no damage is inflicted on the duct wall. This procedure is sometimes employed independently of cholecystotomy.

(*c*) If crushing is impossible, a fine needle may be introduced through the wall of the duct and an attempt made to disintegrate the stone.

(*d*) When all these means fail, the duct must be carefully incised, and, after removal of the stone, sutured with fine silk.

The surgeon may be satisfied that the duct is clear if he can inject fluid through it into the duodenum.

After cholecystotomy, drainage should be employed for a few days, but the tube may be dispensed with as soon as the escape of bile from the wound shows that the common duct is free. The wound usually closes soundly in a few weeks, though occasionally a persistent biliary fistula calls for further treatment.

Cholecystectomy must never be performed unless the common bile duct is patent. It may be required in cases of persistent biliary fistula, or when the gall-bladder is blocked by calculi and, although functionless, causes trouble. The incision is the same as for cholecystotomy; the liver is drawn up and the gall-bladder fully exposed; the peritoneum is incised along each side of it from neck to fundus, and is separated by the handle of the scalpel. The gall-bladder is now readily detached from below up, and the cystic duct is divided between two ligatures. The small flaps of peritoneum are united by chromic gut after any bleeding point has been secured.

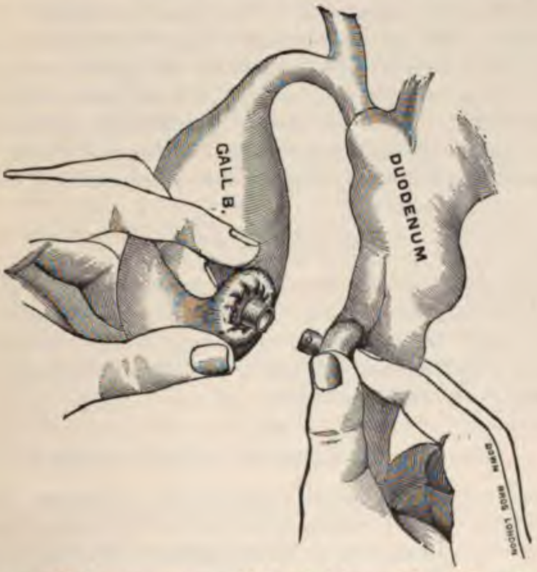

FIG. 119.—Cholecystenterostomy with Murphy's button (Messrs. Down Bros.).

Cholecystenterostomy.—This operation may be required for persistent biliary fistula, or in cases of permanent occlusion of the common duct, which cannot be relieved by cholecystotomy. The incision is preferably made in the right linea semilunaris, but the seat must be varied according to the exact position of the gall-bladder. The gall-bladder and upper part of the jejunum are drawn up into the wound and isolated by sponges. The anastomosis may be effected by Murphy's button (Fig. 119) or some form of bone plate. When the gall-bladder has been incised, its contents should be evacuated before the anastomosis is effected. For a description of the steps of the operation of anastomosis, see p. 429.

THE SURGERY OF THE SPLEEN

SPLENIC AND PERI-SPLENIC ABSCESS

Suppuration in or round the spleen may occur as the result of injury, or in connection with a cyst. Pyæmic abscesses are not amenable to treatment. Abscess of the spleen is a rare condition, and often difficult of diagnosis. The organ is enlarged, and there are the usual signs of suppuration—high fever, chills, rigors, etc. If the abscess is chronic, enlargement of the spleen with increasing pallor may be the only signs. In cases of doubt exploratory puncture may be advisable; but it should be very carefully performed, as it sometimes leads to severe hæmorrhage. If pus is present, it must be evacuated and the cavity freely drained, as in abscess of the liver.

CYST OF THE SPLEEN

Cysts are rare, and are usually due to the hydatid. The organ is enlarged, and fluctuation may perhaps be detected. In the case of hydatid cyst a similar tumour may be present in the liver. The cyst must be opened and drained; but if this fails to effect a cure, splenectomy is the only resource.

CHRONIC ENLARGEMENT OF THE SPLEEN

Malarial enlargement of the spleen may necessitate removal of the organ; but if the enlargement is due to leucocythæmia, this should never be attempted, as all the patients hitherto subjected to operation have succumbed. Occasionally cases are met with which are not traceable to either malaria or leucocythæmia, and the origin of which is doubtful; these are specially suitable for operation if causing trouble.

FLOATING SPLEEN

Floating spleen is a rare condition due to stretching of the peritoneal folds, and is usually met with in women who have borne many children. The symptoms are very similar to those met with in floating kidney, with the addition of digestive trouble. The differential diagnosis depends in the main upon the shape of the tumour, which has a notch in its anterior border. Twisting of the pedicle occasionally results, and should this occur the patient exhibits more or less severe symptoms resembling those of local peritonitis. This accident may lead to suppuration or gangrene. If a floating spleen causes serious inconvenience, which cannot be alleviated by any form of belt and pad, it should be removed.

SPLENECTOMY

This operation may be required for injury, floating spleen, chronic enlargement not due to leucocythæmia, and for abscess or cystic disease, which free incision and drainage have failed to cure, and which is causing grave trouble. The incision, which must be of sufficient length to give the surgeon ample room, is made in the left linea semilunaris, or further out, according to the requirements of the case. Omental and other adhesions must be separated, all bleeding arrested, and the spleen carefully isolated. Care must be taken that the organ is not roughly handled, or it may be ruptured, and dangerous bleeding result. When quite free, the spleen is drawn out of the wound without being rotated, so as to avoid twisting the pedicle. The blood-vessels are carefully isolated, and individually ligatured with silk, and the pedicle is divided half an inch distant. The abdominal cavity is cleansed, and the wound closed. Splenectomy is a dangerous operation, and should never be undertaken without urgent cause. The gravity of the procedure increases with the size of the organ; the most successful cases have been those performed for floating spleen.

SURGERY OF THE PANCREAS

PANCREATIC CYST

Etiology.—The etiology of pancreatic cyst is obscure, and beyond the fact of its association with previous abdominal injury, the causative factors are unknown. The injury may have occurred some years before the cyst is recognised.

Pathology.—The immediate effects of an injury to the pancreas are extravasation of blood and rupture of some of the ducts, and it is suggested that the secretion, continually poured out by the torn ducts, excites, owing to its irritating nature, chronic inflammation; thus a cyst with a fibrous wall is formed, which increases in size by continued secretion from the ducts.

Gussenbauer thinks pancreatic cysts are the result of the digestive action of the pancreatic juice on a diseased pancreas, a small cyst being formed into which hæmorrhage may occur. Boechel suggests that the tumour is really a retention cyst, the duct being strictured as the result of inflammation spreading along it from its intestinal orifice.

The fluid is alkaline, clear, turbid, or greenish in colour, with sp. gr. 1010 to 1020, and contains 1.5 to 3 per cent of albumen, mucin, and a sugar ferment, with tyrosin and urea. The fluid is amylolytic, and may emulsify fats. Hæmorrhage into a pancreatic cyst is not uncommon, and may be very dangerous.

Symptoms.—The general health of the patient suffers in a marked degree, and there is progressive emaciation and loss of strength. There is a distinct globular and smooth tumour in the epigastric region, tending rather to the left side; it moves with the liver, and lies behind and between the stomach and transverse colon, the position of which may be ascertained if necessary by inflation with hydrogen gas, or by water introduced *per rectum*. A sudden increase in the size of the tumour is suggestive of hæmorrhage. Jaundice, due to pressure on the common bile duct, is occasionally noticed.

Fluctuation may be present, and Pitt and Jacobson advise examination for it in the posterior infra-costal region; should it then appear probable that fluid is present, a needle may be carefully introduced to confirm the diagnosis. The fluid withdrawn must be examined with the view of ascertaining its real nature.

Aspiration anteriorly is dangerous, as the needle will probably traverse the stomach or colon. Peritonitis or rupture of the cyst has been thus occasioned.

Treatment.—If the cyst can be detected posteriorly and its nature ascertained, it should be opened and freely drained in this situation; failing this, the abdomen must be opened in the epigastric region to the left of the middle line, over the most prominent part of the tumour. The stomach is pushed upwards and the omentum drawn to one side, or, if this be found impossible, removed. The cyst is now emptied and sutured to the parietal wound. If the cyst be not very tense, it may be left for three or four days until adhesions have formed between it and the abdominal wall.

The Surgery of the Stomach

PYLORIC OBSTRUCTION

Etiology.—Stricture of the pylorus may be due to cancer, fibroid thickening of the submucous coat, contraction of a healed ulcer, or to pressure from without due to implication by a tumour or peritoneal adhesions. Cancer is the most usual cause.

The symptoms are necessarily somewhat modified in their acuteness and severity, according to the precise nature of the obstruction, and hence the tightness and rapidity of its formation.

The history is shorter, and the symptoms more acute and severe, in cancerous obstruction than in that due to non-malignant affections. A history of ulcer does not necessarily imply that cicatricial contraction is the caüse of the obstruction, since cancer not infrequently develops in the seat of an old ulcer. Simple fibrous thickening and peritoneal adhesions usually give a history of long duration, and both are rare instances of obstruction.

The stomach may be found displaced downwards if a tumour of the pylorus, not being fixed by adhesions, has dragged on it.

The stomach is dilated; the area of the note is increased proportionately to the degree of dilatation, which may be made evident, if necessary, by inflation with hydrogen gas, or by administering a carbonate, followed by an acid mixture, but this is not to be recommended. Dilatation of the stomach is accompanied by anorexia, dyspepsia, flatulence, acidity, and vomiting. The vomit is often very copious, and gushes out of the mouth without any trouble or retching. Vomiting occurs some time after food, and not immediately, as is usually the case when the cardiac orifice is obstructed. The vomited matter is acid, frothy, sour smelling, and contains sarcinæ. Pain after food is fairly constant; it is of a neuralgic character, and, in cases of cancer, is usually diffuse, colicky, and severe. Hæmatemesis is not uncommon, and if profuse or persistent, points to obstruction by cancer.[1]

The presence of a definite tumour favours the diagnosis of cancer, but does not necessarily confirm it; nor must failure in its detection be taken as negativing new growth, since it may be concealed by the liver.

In all cases of pyloric obstruction decline in health and strength, and rapid emaciation, are very marked—more so in cancer than in the simpler forms.

Operative treatment.—The operative treatment of pyloric obstruction depends on whether the cause is of a simple or malignant nature. In the former case, pyloro-plasty or Loreta's operation may be undertaken, provided the patient's condition is serious enough to warrant the undoubted risks attending these procedures (p. 382).

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[1] For a further account of the symptoms, the reader is referred to a work on Medicine.

In cases of cancer, the surgeon who moderates his operative ardour, and confines himself to some comparatively simple procedure whereby he may hope to confer material benefit for the remaining months of life, will show the most judicial and humane mind. To operate on all cases of cancerous obstruction is not only to sacrifice life unnecessarily, but brings deserved discredit on the operator. As regards this question, it is impossible to do more than indicate the general lines on which the surgeon should proceed in forming his judgment. In no case should an operation be performed if the patient is rapidly sinking, is the subject of extensive deposits in the liver, or of any organic mischief of the kidneys, or has diabetes. The obese and aged are, in all cases, bad patients for operation. If the general health is fairly good, and relief has not been obtained by dieting, washing out the stomach, and ordinary medical treatment, and especially if vomiting is severe and constant, an operation may be undertaken. In cases of malignant disease requiring relief by operation, gastro-enterostomy (see p. 382) should be performed, for attempts at radical cure by removal of the growth have been uniformly unsuccessful.

GASTRIC ULCER—PERFORATION OF THE STOMACH

Acute ulcer of the stomach may run its course without detection until sudden perforation occurs. In the absence of adhesions the gastric contents escape into the general peritoneal cavity causing intense pain, which commences suddenly in the epigastrium, and is followed by marked collapse, and a speedily fatal termination from acute peritonitis. In some cases a chronic ulcer which may have long caused unequivocal signs may lead to rupture. If adhesions are present, perforation leads to perigastric suppuration. Adhesions are more likely to form if the ulcer is situate posteriorly, the anterior surface being in apposition with the abdominal wall only.

Operative treatment.—If sudden perforation occurs and the state of the patient warrants surgical interference the abdomen should be opened in the middle line, the rent sought for, its margins pared, or the whole seat of disease removed and the wound closed by Czerny's or Lambert's sutures. If the ulcer is posterior, or if there are many vascular adhesions, the operation is one of the greatest difficulty and danger. After the sutures have been introduced the abdominal cavity must be thoroughly cleansed, and a drainage tube should be inserted. The patient must be fed by the rectum for the first four or five days, when small quantities of fluid may be given by the mouth.

PERIGASTRIC ABSCESS

Perigastric suppuration is rare; in the vast majority of cases it occurs as the result of perforation of a chronic ulcer, but in a small minority from the presence of cancer, of gall-stones, and sometimes after injury or from unknown causes. The pus is deeply situated near the diaphragm, usually in the left hypochondrium, and is limited laterally by the spleen and falciform ligament of the liver, and below by the stomach which is adherent to the liver and abdominal wall. The quantity of pus may be considerable, and the abscess may perforate the diaphragm, setting up pyopneumothorax, pulmonary abscess or pericarditis, the symptoms of which are liable to mask the real nature of the mischief. Such abscesses may be tympanitic.

Symptoms. — The patient is perhaps known to have had chronic gastric ulcer, or the history leads to this diagnosis. The advent of suppuration is ushered in by marked collapse, intense epigastric pain, and the usual signs of perforation of the stomach or intestine, the physical signs being however more limited to the epigastric region. When the collapse passes off there is high fever of the remittent type. The pain is persistent, and there may be an area of dulness corresponding with the situation of the abscess; or, should the stomach have been perforated, there may be a tympanitic note from escape of gas. As a rule no tumour can be felt owing to the depth of the abscess. As the pus increases in quantity the diaphragm may be pushed up, the bases of the lungs compressed, and the liver, spleen, and stomach slightly displaced. Pericarditis, left pleural effusion, or pyopneumothorax may, as already stated, complicate the case.

Treatment.—Early operation and evacuation of the pus and free drainage offers the only chance of success. The incision should be made in the middle line in front unless there is evidence, confirmed by aspiration, that the abscess can be reached from behind. If the abscess has already opened into the chest, the removal of a piece of rib, as for empyema, will be necessary. If a perforated ulcer should be found the area of disease must be removed and the stomach sutured.

OPERATIONS ON THE STOMACH

LORETA'S OPERATION—DIGITAL DILATATION OF THE PYLORUS

The stomach having been washed out with warm sterilised water, and the patient anæsthetised, the abdomen is opened by an oblique incision beginning to the right of the middle line, just below the xiphoid cartilage, and carried to just below the cartilage of the ninth left rib. The pylorus is drawn up into the wound; adhesions, if present, are carefully separated, and the stomach is incised parallel with its long axis in the centre of its anterior wall, such incision being two inches long, and reaching nearly to the pylorus. Bleeding being arrested, the index finger is insinuated through the pyloric obstruction—the pylorus being steadied by the other hand—and as dilatation proceeds a second finger is introduced, or a female urethral dilator may be carefully used instead. The dilation must proceed slowly and carefully; the stomach is cleansed and the wound closed as in the operation of gastrotomy (p. 384).

It has been proposed that Loreta's operation should be followed by scraping a carcinomatous mass with a curette, but the operation is one not to be recommended.

PYLOROPLASTY

Pyloroplasty is an alternative to Loreta's operation. When the pylorus has been drawn to the surface, an incision is made along the anterior wall dividing the first inch of the duodenum, the pylorus, and one inch of the stomach; the wound is then united vertically by a double row of Lembert's sutures. The incision made in the long axis of the pylorus is thus converted into one at right angles to it. Good results with much relief have been thus obtained.

PYLORECTOMY

Pylorectomy aims at removal of the disease and consequent attempted cure. It is therefore only of avail when the carcinomatous affection is strictly limited. Diagnosis in this early stage is usually impossible, and the operation is therefore in deserved disrepute.

GASTRO-ENTEROSTOMY

Gastro-enterostomy consists in establishing an artificial communication between the stomach and small intestine through which the gastric contents may pass. The stomach is united to the upper part of the jejunum (gastro-jejunostomy) in preference to the duodenum (gastro-duodenostomy), as the jejunum is more readily accessible, and is not fixed against the spine. The stomach having been previously washed out, the abdomen is opened between the xiphoid cartilage and the umbilicus. The omentum is drawn aside and the stomach and upper part of the jejunum are pulled up into the wound and isolated by sponges. Union is best effected by some form of bone-plate or Murphy's button; the latter allows the operation to be more rapidly performed—a point of great importance in the case of patients whose vital powers are at a low ebb. The after-treatment is the same as for gastrotomy.

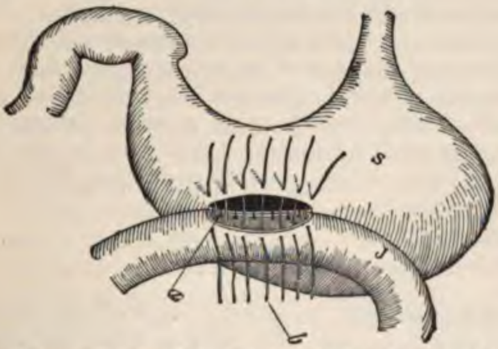

FIG. 120.—Gastro-jejunostomy by suturing. The stomach (*S*) and jejunum (*J*) have been incised longitudinally, and the lower margins of the incisions have been united by the two rows of Lembert's sutures, one passing through the sero-muscular coats and the second uniting the mucous membrane (*a*). A series of Lembert's sutures (*b*) have been inserted through the sero-muscular coat on the opposite side and only remain to be tied (Waring).

Jejunostomy is an alternative to gastro-enterostomy, but the latter is the preferable operation, since it allows food to be taken *per vias naturales*, and hence gastric digestion is accomplished. The risk attending the two operations is about equal. Jejunostomy consists in opening the abdomen and uniting the upper part of the jejunum to the peritoneum and skin as in Littré's colotomy (p. 432). The gut is opened about the fourth day and the patient fed as after gastrostomy.

Duodenostomy has been recommended instead of jejunostomy, but its adoption is negatived by the facts that the duodenum is fixed to the spine, the seat of the artificial opening is near the cancerous pylorus, and moreover the escape of bile through the wound, which is certain to occur, causes much irritation and distress.

GASTROTOMY

Gastrotomy consists in cutting into the stomach for the removal of a foreign body. The abdomen is opened in the epigastric region or by the same incision as for gastrostomy. The stomach is well drawn up into the wound, isolated by sponges, and incised transversely to its long axis midway between the great and small curvatures, the precise place of incision depending on the size and situation of the foreign body. Hæmorrhage from the divided stomach is often free, but is easily arrested by torsion. The foreign body and clots are removed from the stomach and the wound closed by Lembert's or Czerny's sutures of fine silk, care being taken that the peritoneal surfaces are in exact apposition. The sutures should be distant one-eighth of an inch, and should extend one-third of an inch beyond each end of the incision; they must not include the mucous coat. For the first four days the patient must be fed by the bowel, a little ice only being given by the mouth; at the end of this time small quantities of fluid may be administered by the mouth, and after a fortnight milk puddings, jelly, and broth can be taken.

GASTROSTOMY

Gastrostomy consists in forming an artificial opening in the stomach in order to feed the patient when the œsophagus is obstructed. The operation is clearly indicated as soon as the patient is unable to take any solid food; delay beyond this time has too frequently brought discredit on a sound operation. In several cases in which I have performed it both the patient and myself have had ample reason to be satisfied with the result. The abdomen is opened by an incision parallel with, and an inch from the margins of the seventh, eighth, and ninth rib cartilages (Fig. 19, *a*, p. 84). When the rectus is exposed the fibres should be separated vertically with the handle of the scalpel and the fingers; the peritoneum is incised and united to the skin by a few points of suture. The stomach is brought up into the wound as near the cardiac end as possible, the liver and colon being pushed aside if necessary. If the artificial opening is made near the pylorus the escape of the gastric contents is very troublesome. The stomach is best fixed to the abdominal wall in the following way:—A stout needle on a handle is passed through the abdominal wall one inch distant from the margin of the wound, then through the stomach wall, taking up peritoneal and muscular coats only, and again through the abdominal wall from within outwards about an inch distant from the point of entry; the needle is now threaded with silk and withdrawn. This procedure is repeated until the area of stomach is completely drawn into apposition with the abdominal wall, about six sutures being usually required; the ends of each suture are then tied over small pads of gauze placed between them and the skin. A second set of sutures is used to unite the stomach to the parietal peritoneum and margin of the skin. When all the sutures have been inserted the wound is much puckered and about one inch long. A guiding stitch should be passed through the stomach wall to facilitate the second stage of the operation, which should not be performed for about four days, provided the patient's condition permits of such delay. The second stage consists in making a very small opening into the stomach with a sharp knife, slight tension being put upon the guiding stitch. Through this a No. 12 india-rubber catheter is introduced, through which the patient is given a little warm milk; the tube is clamped with a bulldog forceps and retained in position by a strip of plaster. The patient is readily taught to feed himself, a funnel being attached to the tube for this purpose. Fluids thickened with arrowroot, powdered biscuit, or pounded meat and fish may be given. If the condition of the patient is very grave, and feeding by the rectum between the first and second stages of the operation is insufficient, small quantities of milk or beef-tea may be introduced into the stomach through an aspirating needle, which is made to puncture the wall obliquely, so that the gastric contents cannot escape.

PERITONITIS

TUBERCULAR PERITONITIS

Tubercular peritonitis is more common in males than females, and before than after thirty years of age. It presents itself in various aspects, which are not all equally amenable to operation or menacing to life.

Morbid anatomy.—Tubercular peritonitis may occur in a diffuse miliary form, accompanied by considerable effusion of turbid serum, and may complicate general miliary tuberculosis (*serous or ascitic form*); the nodules are scattered over the peritoneum and, by confluence, may form masses of considerable size. In other cases the tubercle is more limited in its distribution, being aggregated into masses matting together coils of intestine and omentum. The tubercular masses may undergo caseation with accompanying suppuration and abscess (*suppurative or ulcerative form*). Owing to the chronic nature of the disease the masses are usually localised by adhesions, and the resulting suppuration is therefore limited. The abscess may burst into a coil of gut, externally, or may spread widely through the planes of connective tissue. In the *fibrous form* the tubercular foci tend to dry up and undergo spontaneous cure with the formation of new fibrous tissue. The abdominal contents may be extensively adherent to the parietes, and hence great care must be observed in the performance of laparotomy.

Symptoms.—The clinical features vary with the course of the morbid phenomena. In most cases the onset is insidious, the history often indicating that the patient has had mild abdominal attacks which have become more severe and been separated by shorter intervals, during which the patient's general health has been indifferent. When the disease is established there is more or less pain and discomfort, with distension of the belly. The masses of tuberculous material may be plainly felt, and fluid, either free in the abdominal cavity, or localised by adhesions, may also be present. In these situations there is dulness on percussion. Dyspeptic symptoms with irregularity of the bowels—diarrhœa predominating—are prominent signs. The patient suffers in general health, and there is slight nocturnal fever with possible evidence of tubercular mischief in the lungs or elsewhere. Owing to the involvement of coils of gut in the tubercular masses, or their constriction by bands of lymph, intestinal obstruction may be caused; operating on such a case sent me by Dr. Martin of Mill Hill, I found the lower end of the ileum occluded by a band of lymph, and the whole peritoneum thickly studded with tubercle. The patient, a boy aged five, made an excellent recovery, the tubercular mischief was arrested, and four years afterwards he was quite well.

Treatment by laparotomy.—Laparotomy gives the best results in those cases which are marked by considerable serous effusion. No operation should of course be undertaken in hopeless cases, or when there is advanced tubercle in other organs.

The abdomen should be opened in the middle line, the fluid evacuated, the peritoneum cleaned by sponging, and iodoform dusted over the tubercular area. The abdominal wound is then sutured without drainage. In localised abscess the cavity must be freely opened and sponged to remove as much tubercular material as possible, care being taken that adhesions are not broken down. The cavity is then treated with iodoform emulsion and drained.

ACUTE SEPTIC PERITONITIS

Acute septic peritonitis may follow on any penetrating injury of the abdomen in consequence of the introduction of pyogenic and infective organisms. It may also arise from inflammation of the vermiform appendix, laceration or pathological perforation of the viscera or intestine, as an accompaniment of acute intestinal obstruction, or of ulceration and cancer of the intestine; or it may be secondary to rupture of a cyst, septic diseases of the female generative organs, or general pyæmia. When peritonitis is due to lesions primarily arising within the abdomen, the causative agent appears to be the bacillus coli communis. This organism is normally present in the intestinal canal, and in healthy conditions does not manifest pathogenic properties, but if it escapes through a perforation or through intact but damaged intestinal walls, it exerts powerful irritant and toxic effects.

Morbid anatomy.—Peritonitis may be general or local, according to the nature and duration of its cause. When the cause is acute, as in perforation of the vermiform appendix, the resulting peritonitis is widespread; but in subacute mischief the secondary inflammation of the serous membrane is limited by adhesions which render the prognosis more hopeful. The abscess thus formed is frequently tympanitic from the presence of gas, with or without rupture of the gut; the pus is always extremely offensive and may, if perforation has occurred, be mixed with fæcal matter.

Non-suppurative peritonitis is characterised by intense congestion of the membrane which loses its natural polish and smoothness and is covered with lymph; this is present in greatest abundance along the lines of contact of neighbouring coils of intestine. Organisation of this lymph leads to permanent matting of the coils to each other, to the parietes, or both. Bands and bridles may thus be formed which may subsequently cause acute strangulation of the bowel (see p. 405).

Symptoms.—The signs of acute peritonitis may come on more or less gradually, but if due to sudden perforation of a viscus they are rapidly developed. The patient is seized with severe pain, intense collapse, and the other usual signs of such an accident. A rigor and sudden rise of temperature is not uncommon.

Pain is general and is accompanied by cutaneous hyperæsthesia, but if the mischief be localised the pain is most severe over its seat. The suffering may be intense and agonising, especially in cases of acute perforation. If the peritonitis is consequent on obstruction of the bowel, pain due to this cause is also present.

Vomiting and nausea are, independently of any obstruction, persistent, and thirst is very troublesome. The patient exhibits the condition, so characteristic of severe intra-abdominal mischief, known as *peritonism*—the face is pale and drawn, the expression anxious and pregnant with the consciousness of the severity of the malady; the surface of the body is cold, the pulse small, hard, and wiry, and the respirations are thoracic and shallow.

The patient lies in the dorsal position with the legs and thighs drawn up to relax the abdomen, which is retracted, flattened, and board-like, though later on it may be much distended. Constipation is the rule and the excretion of urine is diminished.

The bodily temperature varies: in acute obstruction or perforation it may be subnormal, but in peritonitis of puerperal origin and that due to appendicitis or contamination from without, it is usually high.

As the disease progresses the patient falls into the typhoid state; the heart fails, the tongue is dry, brown and loaded with sordes, and there is great nervous prostration with restlessness and jactitation. The causes leading to the fatal issue, which may occur in a few hours or be postponed for a week, are absorption of the toxines of the organism present, and great distension of the intestines in consequence of paralytic obstruction—conditions which may be ameliorated by operation.

Treatment.—In all operations on and injuries involving the peritoneal cavity, the observance of strict asepsis will prevent the occurrence of peritonitis.

When peritonitis has occurred pain may be relieved by solid opium or hypodermic injections of morphia, but the drug must only be given with the view of relieving pain and not as a remedy for the condition as is too often done. Food by the stomach must be given in small quantities and should always be peptonised. The bowel should be emptied by a saline purge; but when the disease is fully established purgatives must be avoided, and they are, of course, contra-indicated if the peritonitis is secondary to intestinal obstruction.

Thirst can be relieved by rectal injections of hot water. Hot fomentations to the abdomen afford marked relief and, if the disease is local, leeches may be serviceable.

Operative treatment.—Localised suppurative peritonitis must be treated like an ordinary abscess, by free incision, drainage, and irrigation, great care being taken that adhesions are not broken down and the mischief thereby diffused. In these cases the prognosis is good.

Diffuse septic peritonitis demands an incision in the middle line, evacuation of the putrid fluid, flushing with normal saline solution, and thorough cleansing of the abdominal cavity by sponging—special attention being paid to the flanks, iliac fossæ, and pelvis. These parts may be freely dusted with iodoform, and a glass drainage tube should be introduced into the recto-vesical pouch.

If the intestine is greatly distended with flatus, the loops should be obliquely punctured with a small hollow needle and emptied. If this method is not effectual, an incision should be made opposite the mesenteric attachment and the contents evacuated, the wound being closed or converted into an artificial anus, according to the condition of the patient.

This procedure is no doubt severe, but under the circumstances gives the best chance of success. Abdominal section for acute diffuse peritonitis is always performed under the worst possible conditions, and every effort must be made to minimise shock and carry out the necessary manipulations with as little delay as possible, for such patients cannot stand a prolonged operation or deep anæsthesia.

The after-treatment is practically that of all abdominal operations. It is to be noted that the abdominal wound frequently suppurates and causes some trouble at first; but if the patient recovers, it heals soundly by granulation.

APPENDICITIS AND PERITYPHLITIS

Inflammation originating in the vermiform appendix is known as appendicitis. Perityphlitis is the name given to inflammation arising outside the cæcum, as a consequence of some abnormal condition of its walls. Appendicitis is the more common condition and leads to the severer clinical symptoms, which are, in both cases, of similar nature.

Causes.—Perityphlitis may be due to ulceration or cancer of the wall of the cæcum. The lodgment of a foreign body in the cæcum or appendix may lead to ulceration and even perforation. In most cases, appendicitis is due to shortness of the mesentery of the appendix, which, especially if the cæcum becomes at any time unduly distended, becomes twisted. When the appendix is thus bent upon itself, mucus accumulates in the tube and, the circulation being impaired, a catarrhal condition, possibly leading to ulceration, is occasioned. If the twist be very acute, gangrene and perforation will speedily occur.

Appendicitis is essentially a disease of early life, the great majority of cases occurring before thirty, and many in much younger patients. Males are more liable than females in the proportion of three to one. Constipation, overloading of the cæcum, and exposure to cold are frequent exciting causes.

Morbid anatomy.—The morbid changes in the appendix depend upon the actual cause and acuteness of the inflammation. If the bending of the tube or impaction of a foreign body be not very severe, a certain degree of catarrh is excited and the patient suffers from repeated inflammatory attacks (*relapsing appendicitis*).

Under these circumstances the repeated congestion leads to thickening of the walls of the tube, to dilatation of its cavity by retained mucus with clubbing of the end, and usually to adhesions binding it to surrounding parts. The mucus retained in the tube may become inspissated and form small masses of considerable density, exactly like foreign bodies (*fæcal calculoids*). If the condition remains unrelieved, ulceration and perforation may occur, leading to the formation of a localised abscess or diffuse septic peritonitis. It must be remembered that the appendix is completely surrounded by peritoneum, and hence all inflammation round it is peritonitic.

If localised abscess forms in the iliac fossa it gradually approaches the surface in the neighbourhood of the anterior superior iliac spine. In chronic suppuration such an abscess may attain a very large size and, passing upwards by the colon, may point in the loin like a renal or lumbar abscess; or it may pass downwards into the pelvis and, in rare cases, open into the bladder or vagina. Perityphlitic abscess may also burst into the bowel, or the delicate adhesions may give way and the pus escape into the general peritoneal cavity. In cases of acute gangrene and perforation of the appendix, the advent of severe pain and acute general peritonitis are the first indications of mischief. The pus of perityphlitic abscesses is intensely foul and may be mixed with fæcal matter, either because perforation of the gut was the primary cause of the mischief, or because the abscess has perforated its wall. These collections of pus may contain large quantities of gas, so that the swelling is tympanitic.

Symptoms.—The symptoms vary in severity within wide limits, their acuteness and gravity being dependent on whether there is simple catarrh, or perforation and gangrene, with acute or chronic abscess; and if the abscess be acute, on whether the pus is limited by adhesions, or excites diffuse general peritonitis in their absence.

The history is sometimes negative, but there may be distinct evidence of previous attacks, sometimes so slight that the patient has taken but little notice of them. Chronic constipation and dyspeptic symptoms are by no means uncommon, and the symptoms may be preceded by some days of constipation. The patient complains of pain and tenderness on pressure in the right iliac fossa, where there is some sense of resistance.

In the majority of cases the symptoms, although pronounced and giving cause for grave anxiety, are not very severe. The course is subacute, and the attack clears up in a week or ten days, perhaps never to return, but more often to be followed at shorter and shorter intervals by others, until some surgical interference is needed not only to rid the patient of a cause of chronic ill-health, but to ensure him against an acute perforative attack which may at any time occur.

If there is much inflammatory exudation a definite mass may be felt, but in many cases this is absent. The pain, on pressure, is most marked at a point midway between the umbilicus and anterior superior iliac spine (M'Burney's point). The patient lies on his back, with the legs drawn up to relieve the tension of the abdominal wall. There is thirst, nausea, slight vomiting which never becomes stercoraceous, and constipation. The temperature is raised about 2° or 3° F. or even higher.

As a rule, such symptoms gradually subside under treatment, but should suppuration occur, they deepen and a distinct tumour is felt in the iliac region.

In more acute cases the symptoms are essentially the same. The onset is more sudden and the temperature rises to 104° or 105° F. There is some degree of tympanites and the usual signs of local peritonitis. A mass may be felt in the right iliac fossa and, as the abscess increases in size and approaches the surface, the abdominal wall becomes red and œdematous. The general condition of the patient is one of prostration, and there is marked peritonism. The pulse is rapid, and the tongue furred with a tendency to dryness. If relief be afforded by evacuation of the pus, the local and general symptoms rapidly improve, but in some cases fatal peritonitis results before anything can be done. Sometimes these cases are ultra-acute; the appendix becomes suddenly gangrenous and the patient dies within twenty-four hours of the seizure.

Diagnosis.—Appendicitis may be mistaken for typhoid fever, the diagnosis between the two conditions depending on the presence of diarrhœa, and the rash in the latter, and the general course of the constitutional symptoms.

Intestinal obstruction, especially ileo-cæcal intussusception, is sometimes confounded with appendicitis; the diagnosis mainly turns upon the obstinate constipation (or bloody diarrhœa in the case of intussusception) and vomiting which distinguish intestinal obstruction, while the peritoneal symptoms are more evident in appendicitis.

Prognosis.—A mild subacute attack of appendicitis usually subsides in about ten days, and in exceptional circumstances the patient has no other. More usually, one attack is the precursor of others which follow at uncertain and gradually shortening intervals, each attack being usually more severe than its predecessor. Permanent recovery may ensue after many attacks, but it is injudicious to trust to such a possibility, since the subjects of relapsing appendicitis are always in danger of an acute perforative attack.

In the more acute and severe cases, the prognosis depends upon whether limiting adhesions form or not. In cases where the general peritoneal cavity is involved, a fatal prognosis will usually be correct.

Treatment.—In subacute cases, absolute rest in the dorsal position should be maintained during the attack and for some days after it, since early movement is liable to cause a relapse. Hot fomentations should be assiduously applied to the iliac region and, if the pain be great, a few leeches may be of service. Opium by the mouth or by hypodermic injection should be given in sufficient doses to allay pain. The bowels may be relieved by enemata, or should they resist this, a small dose (grs. 20 or 30) of sulphate of magnesia should be given.

The diet must be fluid, easily digestible, and given in small quantities; peptonised milk, beef-tea, soup, chicken-jelly, or broth, Brand's essence and meat-juice being the most appropriate nourishment.

If suppuration occurs, the pus must be evacuated by an incision over the most prominent part of the abscess; no attempt should be made to find the perforated appendix, but if it presents in the wound it may be ligatured and removed. Endeavours to find the appendix are usually unsuccessful and, as it is buried in inflammatory tissue, may occasion much harm, the limiting adhesions being broken down and the general peritoneal cavity thereby contaminated. Moreover, the appendix does not cause any subsequent harm; the abscess cavity granulates and closes in a short time, provided efficient drainage and cleanliness be observed.

In very acute cases, where the general cavity of the peritoneum is involved, the abdomen must be opened, the appendix sought for and removed, the peritoneal cavity thoroughly cleansed, and a drainage tube inserted into the recto-vesical pouch. Such a case is practically one of perforation of the bowel and requires the same treatment.

Relapsing cases.—The dangers incurred in relapsing appendicitis are so great that it is usually advisable to rid the patient of his appendix. Treves, who has done so much for intestinal surgery, lays down the following conditions as demanding this operation, which should, whenever possible, be done during the quiescent period:—

(1) Numerous attacks, especially if they are invaliding the patient and increasing in frequency and severity.

(2) When the last attack was of great severity and danger.

(3) When there is persistent trouble in the cæcal region during the quiescent periods.

Operation.—The belly is opened by an incision of sufficient length to give the surgeon ample room, the centre corresponding with the middle of a line drawn from the anterior superior iliac spine to the umbilicus (M'Burney's point). The intestines being kept out of the way by flat sponges, the appendix is sought for and carefully isolated, great care being taken if many and dense adhesions are present. The situation of the appendix is liable to considerable variation, but it usually lies behind the lower end of the ileum, its long axis being in the direction of the spleen; sometimes it is behind the cæcum. When the appendix has been isolated its mesentery should be ligatured with fine silk and divided. The appendix is now removed in the following way:—

Near its cæcal end the coats are divided to the depth of the mucous membrane and turned backwards towards the cæcum as in a coat-sleeve amputation. The mucous membrane is firmly ligatured and cut through on the distal side, the exposed mucous surface being touched with pure carbolic acid to render it aseptic, and the peritoneal surface is securely stitched over the stump of mucous membrane. The wound is cleansed and the abdomen closed. Drainage is seldom necessary. The after-treatment is that for celiotomy.

CELIOTOMY OR ABDOMINAL SECTION

Abdominal section is performed for a variety of conditions which necessitate certain modifications in the operative procedure; but the general technique of all is much the same, and will be considered here. In cases of local suppuration the general peritoneal cavity is shut off by adhesions, and the necessary operation may, in many important respects, be regarded as extra-abdominal.

Preparation of the patient.—When the circumstances of the case permit, the patient should be carefully prepared for operation. In all capital operations the hygienic surroundings of the patient should be, as far as possible, faultless, but this is especially necessary in operations involving the peritoneal cavity owing to the high absorbent properties of the serous membrane. The patient should be kept quiet and carefully dieted for the week preceding the operation; the diet should be generous, easily digestible, and leaving but little solid residue, so that the intestine may not be loaded with waste material. The bowels must be regulated, and on the day before the operation should be cleared by castor oil, followed by an enema in the morning. Food must be withheld for at least four hours before the operation, but if this is likely to be prolonged and attended by much shock, a stimulant nutrient enema should be given half an hour before its performance. The abdomen must be thoroughly cleansed and covered with a carbolised guard; the pubes should be shaved if the incision is to be in its neighbourhood. The umbilical folds must be thoroughly attended to. The bladder should be emptied before the patient is placed on the table.

Avoidance of shock.—The patient must be warmly clad and exposed as little as may be during the performance of the operation, which should be completed as quickly as possible. If much shock be anticipated, an enema should be given as above directed, and this may be repeated during the operation. A hypodermic injection of strychnia (gr. $\frac{1}{60}$) administered half an hour before the operation, acts as a cardiac tonic, thereby minimising shock. The legs should be warmly wrapped up and covered with blankets, and the chest similarly covered, care being taken that respiration is not embarrassed. Hot bottles may be applied to the trunk, or a hot water bed may be used.

Instruments.—All the necessary instruments should be sterilised and placed in 1 : 20 carbolic solution. The sponges should be of various sizes, soft, warm, and thoroughly aseptic. They must be counted before the operation is begun, and again before the abdominal wound is closed, so as to make sure that none have been left in the cavity; if any have been divided during operation the fact should be carefully noted. The strictest asepsis must be observed throughout.

Operation.—The patient being in the dorsal position and fully anæsthetised with chloroform, the abdomen is sufficiently exposed and surrounded with towels wrung out of hot carbolic solution.

The seat of the incision depends upon the nature of the case, but is usually required in the middle line between the umbilicus and pubes. Incisions in the middle line above the umbilicus, in the linea semilunaris, or further out are also frequently used. A small incision, about two inches long, should be made in the first instance if the operation is of an exploratory nature, and this can be easily enlarged with scissors if necessary.

If their direction permits, muscular fibres should be separated with the handle of the knife rather than divided. When the peritoneum is reached it should be picked up with a pair of forceps, carefully opened with the knife and divided with scissors for the rest of its extent. In a case in which adhesions may be expected, great care must be taken that the adherent contents are not opened in mistake for peritoneum.

The cleansed hand is now introduced and the surgeon ascertains as far as possible the extent and connections of the tumour he may be going to remove, and its conditions in respect to adhesions. If the tumour is quite free it must be drawn up into the wound, and, if cystic, emptied by the trocar, introduced at the highest part. The collapsed cyst is then withdrawn, the pedicle defined, and securely ligatured with silk; during this part of the operation the intestine is kept back by flat sponges. If adhesions are present they may, if recent, be gently separated by pressure with a soft sponge; if they are long, they should be clamped, ligatured, and divided. Old adhesions must be separated by careful dissection, or if this does not seem expedient, a portion of the capsule of the tumour may be cut away and left attached to the adherent viscus. In the separation of adhesions force is never to be employed, and the surgeon must be absolutely certain of the identity of any structure he may wish to divide before doing so. When the adhesions are so extensive that complete isolation of the tumour is impossible, its removal cannot be undertaken, and, if cystic, it should be stitched to the parietes and drained, in the hope that it will fill up by granulation. During these manipulations the intestines should be kept back and the seat of operation isolated by the use of flat, soft, warm sponges, which must be carefully counted.

Peritoneal toilet.—Before closing the wound the peritoneal toilet must be performed. In ordinary cases this is quickly done by gently sponging the pouch of Douglas and the flanks with small, soft sponges on holders, and when these are withdrawn unstained nothing further is necessary or advisable, and the parietal wound may be closed. If the peritoneal cavity has been contaminated by dirt, the escape of pus, urine, or cystic fluid, it should be washed out with .5 per cent salt solution made with sterilised water, which may be quickly introduced by an irrigator, the abdomen being gently kneaded to diffuse the fluid throughout the cavity; when flushing is completed the fluid should be removed through a tube introduced into Douglas's pouch, sponging, as above described, being finally resorted to. The absorbent capacity of the peritoneum is very high, and it is not necessary to prolong the operation by removal of all the fluid, provided it be sterile and free from all irritating properties. During flushing it is well to raise the patient's thorax so that the fluid does not gravitate towards, and impede the action of the diaphragm and heart.

Drainage is rarely necessary in simple cases, but if acute peritonitis is present or the cavity has been contaminated in any way, it should be practised by means of a glass drainage tube, or a strip of gauze introduced into Douglas's pouch and brought out at the lower angle of the abdominal wound. It may be taken as a general rule that where flushing is considered advisable, drainage is equally so, and the tube should be retained for a few days until the discharge has practically ceased.

Closure of the wound is best accomplished by silkworm gut sutures, which should be about half an inch distant from each other and introduced through the entire thickness of the abdominal wall half an inch from the margin of the wound. Some surgeons prefer to suture the individual layers of the abdominal wall independently, using for this purpose chromic catgut; at the same time, a few sutures are passed through the whole thickness of the wall, and this plan should be adopted unless the abdomen is naturally lax. When all the sutures have been introduced, the sponges should be removed from the abdomen and a small sponge used in Douglas's pouch to ensure that all has been properly cleansed. The sutures may now be tied, care being taken that a loop of gut is not caught up between a suture and the abdominal wall. Superficial sutures of horse-hair should be inserted between the deep ones.

Dressing and after-treatment.—A dry antiseptic dressing of cyanide gauze and salicylic wool is carefully bandaged on, a double spica being used for the thighs to ensure the lower part of the dressing being kept in apposition. The patient should be kept in the dorsal position, with the knees tied together, and the thighs supported by a pillow. Perfect quietude is essential, and practically no active treatment is required or advisable. If vomiting is troublesome, the nurse should place her hand over the situation of the wound to give support during retching, and teaspoonful doses of hot water may be occasionally given with benefit. Severe shock must be treated as described on p. 21, vol. ii. Morphia should be avoided if possible, since it tends to increase flatulence, which always causes more or less distress. Flatulence may be relieved by the use of hot water, peppermint, or cajuput oil, a few drops being administered on a lump of sugar every half hour; if the distension and distress are marked, the introduction of the rectal tube may give relief, but greater benefit is derived from a saline purge, provided the nature of the operation does not contraindicate it. Thirst is generally very trying and is best relieved by enemata of hot water; the mouth may also be swabbed out with glycerine and water, or with a weak solution of citric acid, and small lumps of ice may be sucked. As a rule, but little food is necessary for the first twenty-four hours, and what is necessary should be given in the form of peptonised enemata. After this period the diet must depend upon the nature of the operation; in simple cases beef-tea and similar food may be given in small quantities by the mouth, solid food being allowed on the third or fourth day. Milk is better peptonised, otherwise it is indigestible and productive of flatulence. If the patient is unable to void the urine after abdominal section, the catheter should be used when the bladder requires emptying.

CHAPTER XIX

INTESTINAL OBSTRUCTION—OPERATIONS ON THE INTESTINES

THE importance of a thorough knowledge of the causes, symptoms, and treatment of intestinal obstruction cannot be over-estimated.

Of late years an immense amount of work has been done in this direction, and there can be no excuse for allowing patients to die of obstruction without the help of surgery; the days of a blind faith in opium and the *vis medicatrix naturæ* are past. In considering the subject it will be most convenient to give first a general account of the symptoms which lead the surgeon to diagnose obstruction, and then to discuss in detail the pathology, special signs, and appropriate treatment of the various causes which may induce the trouble. Intestinal obstruction may be acute, subacute, or chronic; or an acute attack, varying in severity, may come on during the progress of chronic obstruction.

Symptoms of acute intestinal obstruction.—Acute obstruction is characterised by its sudden onset, with severe pain, shock, vomiting, and constipation as the leading symptoms, culminating in death, usually within ten days, unless some means are taken to give relief.

Pain.—The patient is seized with sudden, acute, often agonising pain in the abdomen, referred to the region of the umbilicus, but there is no general tenderness unless acute peritonitis sets in. Local pain at the seat of obstruction is not usually present, and the situation of pain must not be taken as a guide for the incision in laparotomy should this operation be called for. The localisation of the pain at the umbilicus is due to its being referred to the solar plexus, which lies just above and a little to the right of this spot.

Treves has pointed out that when the obstruction is complete the pain is continuous, perhaps with paroxysmal exacerbations, due to strong peristalsis of the gut above the obstruction; but if it is incomplete, the pain is paroxysmal, the patient being in comparative ease during the intervals.

Pain is often caused by taking food and occasionally by the use of an enema, both acts exciting peristalsis. It is always of a colicky nature, and may, if the obstruction is acute, be so severe as to occasion dangerous collapse. Pain quickly subsides if the obstruction is overcome, and it also diminishes shortly before death. Its cessation under opium must not give rise to a false sense of security.

Vomiting is an early and most important sign. It is accompanied by, but does not usually relieve, an intense feeling of nausea. At first the vomited matter consists of the contents of the stomach, often mixed with bile; then the small intestine evacuates its contents, and by the third day or earlier the vomit is distinctly stercoraceous, with a fœtid odour. If the obstruction is high up in the small gut the vomit is never really fæcal, though it may, from decomposition, have a distinctly fæcal smell.

In some cases the vomiting is persistent and severe; the patient (in spite of the fact that he takes no food and but little liquid) brings up, often without effort or retching, many pints of fluid vomit. The vomiting is reflex and the contents of the small intestine are ejected as the result of a return wave passing up the centre of the tube from the seat of obstruction, and not, as was formerly supposed, of inverted peristalsis.

Constipation is usually complete from the first, but the bowel below the obstruction may empty itself, especially if an enema be given. Even if there is an accumulation of fæcal matter below the point of obstruction it by no means follows that this will be evacuated, since the bowel itself may be reflexly weakened or paralysed.

Flatus is not passed *per anum*, but it should be remembered that after the use of an enema a little flatus, which has been introduced, may escape. Fœtid eructations are common, especially towards the end, when hiccough may set in.

Meteorism, *i.e.* distension of the bowel by gas, is absent at first and may be so throughout, its presence and amount being in the main dependent on the nature and seat of the obstruction. Thus it is more marked in acute than in chronic obstruction, and proportionally more so if the obstruction is low down; in volvulus of the sigmoid flexure it is an early, well-marked, and very distressing symptom. Meteorism is dependent upon and proportional to the degree of vascular obstruction and becomes more pronounced with the advent of acute peritonitis and intestinal paralysis.

The **general condition** is one of collapse. The degree of shock varies according to the actual cause and acuteness of the obstruction, the severity of the pain, the amount of bowel involved, and the nervous excitability of the patient. Other things being equal, shock is more severe in obstruction of the small gut owing to its more intimate nervous connections. The temperature and pulse are lowered, the skin is pale and cold, and the face denotes anxiety and apprehended danger. The respiration is often shallow and may be much impeded if there is marked distension of the abdomen. There is usually great thirst and clamminess of the mouth with furring and dryness of the tongue.

Towards the end the temperature may rise with the onset of acute peritonitis, or in consequence of general poisoning by the absorption of septic materials through the bowel or peritoneum, and the patient, sinking into an apathetic listless condition, succumbs.

Owing to reflex renal inhibition, the **quantity of urine** is usually diminished, and towards the end there may be total suppression; the diminution is met with in acute cases, and is not, as has been asserted, proportional to the proximity of the obstruction to the pylorus.

Physical examination.—In all cases, the possible seats of external hernia, the rectum and the vagina (in the case of married women) should be examined. When the pain is paroxysmal, the abdomen should be examined during a paroxysm and also in the quiescent period; in doubtful cases, and especially in those which are subacute or chronic, frequent examinations should be made.

Inspection.—In the early stages the abdominal wall is usually flaccid, but as the case proceeds, and especially it acute peritonitis comes on, there is rigidity with increasing distension. If the obstruction be in the small gut the distension is mainly in the central line, and if high up above the umbilicus. When the colon is affected the flatus accumulates along its line, not being able to pass the ileo-cæcal valve; hence the flanks and epigastric region are bulged, and there may be considerable difficulty in respiration.

Coils of intestine may be seen moving beneath the abdominal wall, especially if the patient be thin; this is not a very evident sign in acute cases, it being an indication of hypertrophy of the intestinal wall in response to increased work demanded by some chronic obstruction.

Palpation and percussion sometimes reveal the presence of a tumour if the cause of obstruction is of such a nature, *e.g.* intussusception, as to produce one. The tumour is, however, quite as often undetected as felt, and hence its absence must not be given great importance in arriving at a differential diagnosis. Palpation must be carefully conducted, the palmar aspect of the hands and fingers being laid flat upon the abdomen.

Auscultation.—Borborygmi may be very marked during an attack of pain.

If the colon is unobstructed, water injected *per rectum* may be distinctly heard passing backwards to the ileo-cæcal valve, over which the stethoscope should be placed. This is rarely necessary for diagnosis, and should not be employed in routine practice as it may occasion considerable distress.

Symptoms of chronic intestinal obstruction.—In the majority of cases the onset is gradual, the patient frequently consulting his medical man for "dyspepsia." He complains of periodic attacks of pain, usually in the neighbourhood of the umbilicus, general abdominal uneasiness, a sense of fulness after food with flatulent dyspepsia, and increasing trouble in obtaining a free action of the bowels. Such attacks are liable to occur at various periods, and are often brought on by dietary errors. The attacks recur with increasing frequency and severity until the above symptoms, combined with nausea and vomiting, lead the patient to seek relief. Constipation is the rule; at first perhaps causing but little trouble, and being easily overcome by laxative medicines, it becomes more and more troublesome until the patient may find no relief for many days, and then only after the use of strong purgatives and perhaps enemata. The constipation is, however, by no means constant, but alternates with attacks of spurious diarrhœa. As the obstruction becomes more marked the suffering increases; the abdomen becomes distended and peristaltic movements may be seen through the abdominal wall; the general health suffers considerably, the tongue becomes foul, the breath offensive, the appetite fails, and the patient is pale, weak, and emaciated. Attacks of subacute obstruction are not uncommon, and are due to temporary plugging of the narrow bowel by scybalæ or masses of undigested food. Such attacks may be overcome by judicious treatment without operation, or an acute attack may supervene, or may indeed be the first sign of anything wrong. Death may result from simple exhaustion, from perforation of the bowel above the seat of disease, or from acute obstruction. In the great majority of cases the cause of chronic obstruction is situated in the great intestine.

Diagnosis of intestinal obstruction.—The diagnosis of the fact of obstruction is usually sufficiently clear from the symptoms, but the diagnosis of the actual cause of the obstruction is arrived at only by a careful analysis of their relative severity and by their modification. The fact of obstruction may be confounded with acute abdominal symptoms caused by peritonitis or appendicitis; absolute constipation and persistent vomiting which usually becomes fæcal are strongly indicative of obstruction. As regards the seat of the obstruction, it may be generally stated that most acute cases have their origin in the small gut, especially the lower part of the ileum; obstruction in the colon is essentially chronic, since its capacity is greatér and its function mainly mechanical; volvulus of the sigmoid flexure is an exception. The symptoms are most marked when the small intestine is affected, especially if the obstruction be high up; the pain and collapse are great, the vomiting is persistent and becomes stercoraceous, and the attacks of pain are much aggravated by food. When the abdomen is distended by obstruction in the small intestine, it is bulged in front, the flanks being relatively flat, unless the distension be very great. When the large intestine is obstructed, the distension is chiefly seen in the flanks and epigastric region, the hypogastric and umbilical being comparatively normal.

The morbid conditions producing intestinal obstruction—**Acute intestinal obstruction** may be due to one of the following causes, each of which will be considered in detail:—[1]

(1) Strangulation by peritoneal or other bands.
(2) Internal hernia.
(3) Volvulus.
(4) Intussusception.
(5) Impacted foreign bodies.
(6) Sudden occlusion of a stricture.

Chronic obstruction is due to

(1) Stricture of the bowel.
(2) Chronic intussusception.
(3) Fæcal accumulation.
(4) Foreign bodies.
(5) Compression of the bowel from without.

It must be remembered that in many forms of chronic obstruction, attention is first called to the mischief by the supervention of an acute or subacute attack. In such cases, the real nature of the cause may be clearly indicated by a careful investigation of the previous history extending over a period of six months or more. As a rule, when urgent symptoms appear in the course of chronic obstruction, they are subacute rather than acute.

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[1] Strangulated hernia is not included in this chapter (see p. 450).

Prognosis and causes of death.—In acute cases the prognosis depends in great measure on the completeness of the obstruction, the degree of interference with the blood supply, and the length of gut involved. When these factors are marked, the course of the case is rapid and death occurs in from three to ten days, unless the cause is of such a nature that it can be remedied by surgical interference. It is of great importance to remember that early operation is essential to success, every hour which passes diminishing the patient's prospects of recovery. The fatal result may be directly due to shock, or to shock and exhaustion combined, caused by the constant pain, the vomiting, and inability to take or assimilate food. Gangrene and perforation or rupture of the bowel may terminate the case. Septic poisoning is also an important factor. In chronic cases the patient may die of acute obstruction, but more usually from exhaustion, or perforation of the bowel. Chronic obstruction usually kills within six months of its detection. If the obstruction be due to cancer of the bowel, death quickly ensues.

General treatment of acute obstruction.—The curative treatment of acute obstruction is essentially operative ; but pending a definite diagnosis of the fact of obstruction, and in subacute or chronic cases when the symptoms are not very urgent, certain means may be adopted for the patient's relief.

Position.—He should be placed upon the back, with the thorax slightly raised and a pillow beneath the thighs in order to relax the abdominal muscles.

Feeding must be entirely by enemata, unless the obstruction be low down in the colon, as in volvulus ; in the latter case enemata can hardly be given, and, moreover, the patient is able to tolerate food in small quantities by the stomach. Food by the mouth excites vomiting and pain, aggravates the general condition and, even if retained, is digested and absorbed imperfectly, or not at all. Peptonised beef-tea, meat suppositories, and the like may be given every hour or so, the maintenance of the patient's strength being of the utmost importance as regards the ultimate issue of the case.

The intense thirst should be relieved by ice in the mouth, and especially by enemata of hot water.

Enemata and aperients.—Enemata of soap and water with a little turpentine, gradually introduced by syphon, afford a good deal of relief by emptying the colon; but they are useless as curative agents, excepting perhaps in intussusception of the colon or ileo-cæcal valve. In cases of obstruction of the small gut, an enema cannot reach the seat of the mischief, as the ileo-cæcal valve offers a bar to the further passage of the fluid. If enemata aggravate the symptoms, as they sometimes do, they should be discontinued.

Aperients should never be given in acute obstruction; they excite violent peristaltic action and acute pain, and under no circumstances can they be productive of anything but harm.

Opium should always be given, preferably by hypodermic injection, in doses sufficient to quiet and ease the patient. When the drug is fully used the improvement in the general condition is very marked, but the surgeon must be careful not to be thus blinded to the real nature and gravity of the case, or to postpone operation until too late. Under the influence of opium, pain and vomiting are less severe, shock tends to pass off, the temperature improves, the pulse is strengthened, and the secretion of urine is encouraged.

The cessation of the pain is due in part to the direct anæsthetic effects of the drug, but chiefly perhaps to the fact that its cause, viz. irregular and strong peristalsis, is held in check in consequence of the sedative action of the drug on the nervous mechanism.

Warmth.—Hot fomentations usually afford considerable relief, and should be regularly applied.

The use of **metallic mercury**, **insufflation** of air, **inversion** of the patient, and **massage** of the abdomen have all had advocates, but at the present time few would be inclined to adopt such measures.

Laparotomy.—Although the above general treatment will do much to mitigate symptoms, it must of course not be relied on for cure, and as soon as the diagnosis of acute obstruction is made, no matter whether its precise cause be diagnosed or not (and this is often a very difficult matter), an exploratory laparotomy should be performed.

Much depends upon the actual condition of the gut involved in the obstruction, and upon that of the coils above, and as these conditions become less hopeful with the lapse of time, the operation should be performed without delay. To postpone laparotomy when once the diagnosis has been made is to court disaster. If peritonitis is already present, especially if it is due to perforation of the bowel, the case is desperate indeed.

The abdomen should be opened in the middle line below the umbilicus, and the distended coils of bowel which then protrude at the opening must be kept back by gentle pressure with warm, flat sponges, and not be allowed to escape for fear of deepening shock; but if the distension is so great that this cannot be readily done, the distended coils may be punctured with a fine trocar, or the contents may be evacuated by an incision which is afterwards closed by Lembert's sutures (see p. 425).

The hand is now introduced into the abdomen and the cæcum sought for; if this be found distended, the obstruction is in the colon, which should be examined by passing the hand along it from cæcum to rectum. If the cæcum be found collapsed, the lower end of the ileum must be drawn up and the gut passed through the fingers, being replaced segment by segment as it is examined until the seat of obstruction is arrived at. This method of examination has the great advantage of shortening the operation, and the distended and congested coils are but little manipulated. When the cause of obstruction has been discovered, it must be remedied according to its nature. The abdomen is now sponged out and the wound closed. If acute peritonitis be present, it will be necessary to employ drainage.

INTESTINAL OBSTRUCTION DUE TO "BANDS"

Bands of adhesion due to local attacks of peritonitis may attain considerable length in consequence of the traction put upon them by intestinal movements. They are usually rounded and slender, but may be broad and flat, and although generally single (solitary bands) are sometimes multiple. Any cause exciting local peritonitis, *e.g.* disease of the mesenteric glands, or inflammation round a segment of bowel which has been in a strangulated hernia, may result in their formation; or a portion of omentum, the vermiform appendix, the Fallopian tube or Meckel's diverticulum may, when bound down at the free end, become practically such a band.

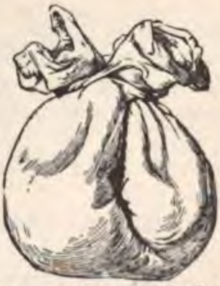

FIG. 121.—Strangulation of the small intestine by a fine band of adhesion which forms a complete circle round the coil, and is attached to each end of the gut (Westminster Hospital Museum, No. 531. Drawn by C. H. Freeman).

Meckel's diverticulum (vitelline duct) is generally situated on the free margin of the ileum within three feet from the ileo-cæcal valve. It rarely exceeds three or four inches in length, and may be either a mere slender fibrous cord or else fully formed gut; its free end may become attached to any part, but is so most often to the mesentery.

Mechanism and seat of the obstruction.—A band usually causes obstruction by forming an arcade under which a portion of gut is ensnared; this is more likely to happen if the free end of the band be adherent to some resisting structure, *e.g.* the parietes. As the gut passes beneath the band it is frequently twisted on its mesenteric axis so that volvulus is also present. More rarely the band, if long enough, actually snares a coil of gut in a loop.

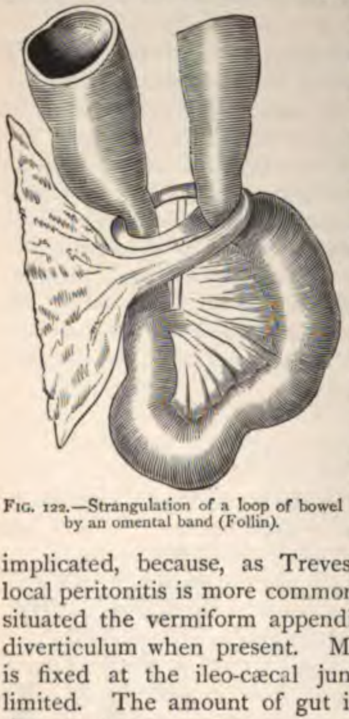

FIG. 122.—Strangulation of a loop of bowel by an omental band (Follin).

In whichever of these ways the gut is caught, the pressure to which its walls is subjected affects first the venous circulation, and hence œdema is occasioned. This swelling still further prevents reduction and tightens the strangulation, which may be very severe.

The lower end of the ileum is nearly always the portion of gut implicated, because, as Treves points out among other reasons, local peritonitis is more common in the pelvic region; here also are situated the vermiform appendix, the Fallopian tube, and Meckel's diverticulum when present. Moreover, the lower end of the ileum is fixed at the ileo-cæcal junction, and hence its excursion is limited. The amount of gut involved may be as much as two or three feet.

History.—Obstruction by bands is most usual between the ages of twenty and forty, and is rather more common in males. According to Treves, there is a history of old peritonitis, obscure abdominal mischief, or hernia in about 68 per cent of all cases; in the remainder the history is negative. Such a history may date many months or even years before the acute obstruction. In some cases the patient may from time to time have had obscure abdominal pains with constipation, even amounting, in rare instances, to temporary subacute obstruction.

Symptoms.—The signs common to all acute obstructions are present. The onset is nearly always sudden, and is ushered in by persistent colicky pains at the umbilicus, but unaccompanied by abdominal tenderness unless acute peritonitis supervenes. There is marked nausea, unrelieved by the vomiting, which is persistent and profuse, and becomes stercoraceous about the third day.

Constipation is usually complete from the first, and no flatus is passed *per anum*, although there may be offensive eructations, especially when meteorism—which is absent at first and never very marked—makes its appearance.

The abdomen, flaccid for the first day or two, becomes swollen and tympanitic, notably in the middle line, the flanks remaining flattened. There is hyper-resonance, but no dull area, local sense of resistance, or tumour; and examination of the rectum gives a negative result.

The general condition of the patient is as described at p. 400. Thirst is a very distressing symptom.

This form of obstruction is rapidly fatal unless operative measures are early adopted.

The diagnosis of a band is usually only made after the abdomen has been opened, but it may be suspected if, with the above symptoms, there is a history of antecedent peritonitis.

Treatment.—The abdomen must be opened in the middle line, and the cause of obstruction sought for.

When the band is reached it should be ligatured and removed, and if the gut has been twisted on its mesenteric axis it should be restored to the normal position. If the coils of bowel above the obstruction are much distended, they may be punctured, or an opening made, and the contents evacuated. The opening should be closed if the patient's condition admits; otherwise it is safer and quicker to make an artificial anus at the site of the laparotomy wound, which can subsequently be dealt with if the patient recovers.

INTERNAL HERNIA

A portion of gut, usually the ileum, may pass through a congenital or traumatic opening in the mesentery or omentum, and may at the same time be twisted on its own mesenteric axis.

A hernia may also occur through the foramen of Winslow, the gut—usually the colon—passing into the small sac of the peritoneum. Such herniæ are sometimes very tight, and cannot be reduced, since the use of the knife is interdicted in view of the position of the hepatic vessels and other important structures. Hernia may also occur at the fossa duodeno-jejunalis, intersigmoid fossa, and pericæcal pouches; in the first the upper coils of the jejunum are herniated, and in bad cases the ileum follows. Hernia of the ileum at the pericæcal pouches passes up behind the cæcum.

The symptoms are identical with those caused by bands, the diagnosis being made when the abdomen is opened. Hernia at the fossa duodeno-jejunalis may be very large, the greater portion of the gut escaping and distending the peritoneal pouch. In such cases a considerable tumour, projecting downwards and to the left of the umbilicus, results. The symptoms may be acute, subacute, or chronic.

Treatment.—The abdomen being opened, an attempt must be made to reduce the gut, the peritoneal pouch being divided if necessary. In the case of hernia through the foramen of Winslow, no attempt must be made to divide the constricting band, consisting as it does of the hepatic artery, portal vein, and bile duct in front, while posteriorly is the vena cava.

VOLVULUS

Varieties and seat.—By volvulus is meant that condition in which the blood-vessels and lumen of the bowel are obstructed by its twisting either (1) on its own mesenteric axis, or (2) by two adjacent coils winding round each other.

Volvulus is most common at the sigmoid flexure, which either twists on a long mesentery of its own, or being loose and pendulous, engages with a coil of small intestine; it may also be met with at the cæcum and ascending colon, or in the small intestine.

It commonly happens that when a portion of gut is strangulated by a band, the coil is somewhat twisted on its own or on its mesenteric axis, and thus produces volvulus as a super-added condition.

In two-thirds of all cases, volvulus occurs at the sigmoid flexure, which twists on an abnormally long and narrow mesentery, so that the gut forms a large loop. When the anatomy of the parts is normal, volvulus is impossible. The abnormality may be congenital, or the mesentery may have been gradually stretched by the tension of a chronically over-distended colon. The actual occurrence of volvulus is probably induced by distension of one part of the sigmoid loop, or by irregular peristalsis. In most cases the upper segment passes downwards and in front of the lower, but occasionally it passes behind. The twisting occludes the lumen of the gut at both ends of the loop and seriously hampers the circulation, causing intense congestion and sometimes gangrene; the loop itself is much distended by gas and sometimes by fluid. The condition is increased and made permanent by the accumulation of gas in the coil, which may be so distended that the peritoneal coat ruptures. Peritonitis sets in early and becomes general, but perforation is rare.

When the sigmoid becomes engaged with a coil of small intestine, the condition of the loop and mesentery are as above described, and the coil of small intestine usually lies in front of the sigmoid loop, winding round it from below upwards, backwards, and downwards; thus both segments are strangulated.

When volvulus occurs at the cæcum and ascending colon, the anatomy is the same as at the sigmoid. Volvulus of the small intestine may be either a twist of a coil on its mesenteric axis, or the engagement of two coils twisted round each other; the latter is very rare, and not likely to occur unless one of the coils be fixed.

When the gut twists on its own mesentery, which is longer than normal, the twist is usually one complete turn from left to right, and causes obstruction at both ends of the involved coil, with great vascular embarrassment.

History and symptoms.—Volvulus is more common in males than females in the proportion of four to one, and usually occurs between the ages of forty and sixty years. In most cases there is a history of chronic constipation. The patient is suddenly seized with an acute paroxysm of severe pain, accompanied by more or less collapse. At first the pain is intermittent, but, as the twist gets tighter and the obstruction complete, it is continuous, but perhaps accompanied by temporary exacerbations. The pain is referred to the umbilicus, and when peritonitis sets in there is also local tenderness which gradually spreads over the abdomen. There is considerable nausea, but vomiting—which gives a certain measure of relief—is slight or absent, and rarely stercoraceous; volvulus of the small gut is however accompanied by early, constant, and stercoraceous vomiting. Constipation is complete from the first, and there is marked tenesmus. The use of the enema shows, in volvulus of the sigmoid, that water cannot be injected beyond the rectum. Meteorism occurs early and is very pronounced, the distension being so great that the action of the diaphragm is materially impeded. The abdominal wall is rigid and hyper-resonant. The general condition of the patient is the same as in all forms of acute obstruction. Death occurs within the week.

Treatment.—Spontaneous cure never occurs in volvulus, and hence operative measures must be at once resorted to. Laparotomy should be performed, the coil opened at the upper part, and the contents evacuated. If after evacuation of the contents the coil can be untwisted, and does not show any tendency to re-twist, the opening in the gut should be sutured, the coil returned, and the abdomen closed. If re-formation tends to occur, the opening in the gut must be converted into an artificial anus. Sometimes even after evacuation of the contents of the bowel it is found impossible to reduce the volvulus, and lumbar colotomy must be performed. If the condition of the patient is grave and the diagnosis is certain, lumbar colotomy should be immediately performed, laparotomy under such circumstances being fatal.

ACUTE INTUSSUSCEPTION

Morbid anatomy.—Intussusception consists in the invagination of a segment of bowel into that below it. The invagination is, in practically all cases, from above down, and occurs in the following forms:—

(1) **Ileo-cæcal**, 44 per cent. The ileum and cæcum invaginate into the colon, the ileo-cæcal valve forming the apex of the intussusceptum which may be so long as to project at the anus.

(2) **Ileo-colic**, 8 per cent. The ileum is prolapsed through the ileo-colic valve. In this form the growth of the intussusception is at the expense of the intussusceptum, contrary to the general rule.

(3) **Enteric**, 30 per cent. The intussusception is short, and usually involves the lower part of the jejunum, and sometimes the ileum.

(4) **Colic**, 18 per cent. Intussusception of the colon usually takes place in its lower half, and is generally short.

An intussusception consists of six layers of bowel, three on each side of the central slit-like lumen. Peritoneum is in contact with peritoneum, and the mucous membrane with mucous membrane. The outer layer on each side constitutes the sheath or *intussuscipiens*, the middle is the entering and the central the returning layer. The entering and returning layers together constitute the *intussusceptum*.

In rare cases an intussusception is double or triple, the layers then numbering ten or fourteen respectively.

The mesentery lies between the entering and returning layers of the intussusceptum, and owing to its tension, the whole tumour is somewhat curved and sausage-shaped, the concavity being on the mesenteric side (Fig. 123). As an intussusception increases in size, it does so, except in the ileo-colic form, at the expense of the sheath, so that the apex of the intussusceptum always remains the same.

In the early stages an intussusception can be easily reduced, but certain changes speedily occur which render reduction dangerous or impossible. The mesenteric vessels being unduly compressed between the entering and returning layers of the intussusceptum, these, especially the latter, become intensely congested and swollen, and ultimately gangrenous. At the same time local peritonitis occurs, and the opposed peritoneal surfaces become matted by plastic lymph, which at first is soft and easily lacerable, though in a few days the adhesions are strong enough to prevent reduction.

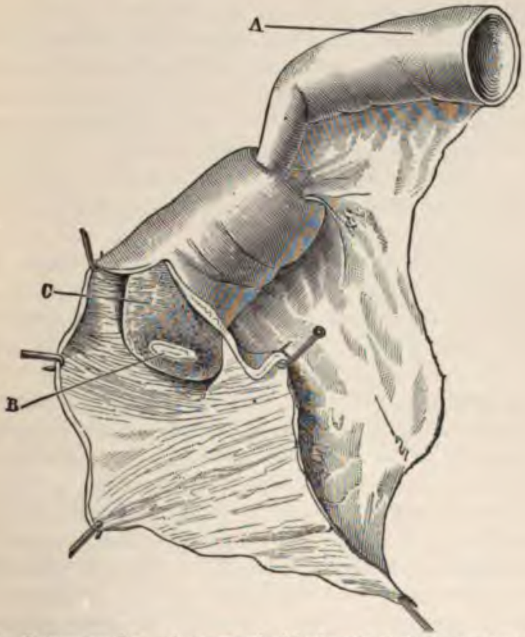

FIG. 123.—Intussusception. *A*, upper end of the bowel; the lower end has been laid open to show the invagination (*C*) with the central opening (*B*), (Follin).

The lumen of the bowel is necessarily much diminished, the narrowing being increased by the curvature of the tumour and swelling of the intussusceptum.

The sheath undergoes but little change. The local peritonitis may become general and prove fatal; or, in more favourable cases, it serves to unite the bowel, and the invaginated portion, becoming gangrenous, sloughs away, and spontaneous cure results. Sloughing by no means always results in cure; it may, indeed, prove fatal by perforation.

Causes.—Intussusception is dependent upon irregular contraction of the bowel. Treves states that the formation of intussusception is due in the main to the action of the longitudinal muscular fibres, which draw the lower uncontracted segment of bowel (*i.e.* the sheath) over the contracted, and consequently smaller, part above it (*i.e.* the intussusceptum); he points out that, when once invagination has occurred, its increase is dependent upon continued contraction of the sheath, excited by the intussusceptum acting as a foreign body.

As to the causes which induce the initial irregular contraction which culminates in intussusception, it appears that diarrhœa, the presence of undigested food, of a polypus or other tumour in the wall of the gut, may, in some cases at least, be determining influences.

Intussusceptions of the dying are met with more often in children than adults. They may be distinguished from ordinary intussusceptions by the following facts:—They occur in the ileum or jejunum, are always short, frequently multiple, and often retrograde, *i.e.* the invagination is from below upwards. There are no signs of morbid action at the part, and reduction is easy.

Symptoms.—Intussusception is a common cause of obstruction, and in the acute and subacute forms is usually met with in children under ten years of age. A subacute intussusception is one lasting over a week and not more than a month. Intussusceptions lasting more than a month are called chronic, and are more common in adults (p. 414).

The onset is sudden. Pain is moderately severe, and tends to abate when the invagination has attained its full size. It is usually paroxysmal, but may be continuous, with exacerbations, and is due to peristalsis; it is accompanied by local tenderness over the tumour.

Vomiting is not a constant or marked symptom, and, like the pain, is often paroxysmal with long intervals between the paroxysms.

The vomited matter rarely becomes stercoraceous. There is marked tenesmus, especially if the intussusception is low down. At first there is diarrhœa with bloody mucus, but as the swelling increases and the lumen through the intussusception is narrowed no fæcal matter passes, the stools being composed of bloody mucus only.

The abdominal wall is usually flaccid, and there is but little meteorism unless general peritonitis supervenes. The detection of a tumour is possible in about half the cases, and is usually evident in the ileo-cæcal form. The mass is cylindrical and sausage-shaped, varying in length and size and becoming more evident during a paroxysm of pain. In cæcal or colic intussusception a tumour may be present in the rectum, or even at the anus. Such a tumour will not be attached to the mucous membrane of the gut, and has itself a central lumen. These points, coupled with the general symptoms, serve to diagnose the mass from a tumour.

Prognosis.—There is no doubt that acute intussusception sometimes undergoes spontaneous reduction, and in some cases there may be a distinct history of this having taken place some time previously. Cure by sloughing occasionally occurs (usually in about ten or fourteen days); most cases die, however, either from exhaustion, perforation, or occasionally from hæmorrhage.

Acute intussusception is very fatal, especially in very young children, the death rate being estimated at about 70 per cent.

Treatment.—Opium should be given in sufficient quantities to arrest all pain and quiet the peristaltic action of the bowel. By its use the patient is eased and the growth of the intussusception arrested. It has occasionally happened that an intussusception has, during the first twenty-four hours, been reduced by kneading the tumour through the abdominal wall. This treatment is, however, only applicable to quite early cases in which the tumour is small and as yet not much swollen and is free from adhesions; it is, moreover, quite impossible to carry out the kneading with any certain knowledge of what is actually being done. The injection of water *per rectum* is sometimes employed, but is likewise only suitable for quite early cases in which no adhesions are present. If it is employed the patient should be anæsthetised, and the buttocks being well raised, warm water is then introduced by means of a funnel and tube, the degree of pressure being estimated by the height to which the former is raised. The anus should be tightly closed round the tube to prevent leakage. The water must be retained for fifteen to twenty minutes, for reduction is accomplished rather by slight and long-continued force than by great sudden force which may do much harm. The injection of air by Lund's insufflator or an ordinary pair of bellows may be tried in place of water.

In most cases it is wiser to perform a laparotomy at once. The abdomen is opened in the middle line; the intussusception is examined, and if from its appearance reduction seems possible this should be attempted by gently squeezing and kneading the sheath, combined with slight traction on the intussusceptum. In about half the cases reduction is impossible, and should this be so, resection of the intussusception and approximation of the gut with Murphy's button is the appropriate treatment. The alternatives to resection are short-circuiting the gut, or the establishment of an artificial anus above the obstruction. Both of these operations have the great disadvantage of leaving the disease untouched. Laparotomy for intussusception complicated by further operation on the intestine is extremely fatal.

CHRONIC INTUSSUSCEPTION

The general statements made at p. 410 *et seq.* apply with certain modifications to the chronic disease. Chronic intussusception occurs in 50 per cent of the cases as the ileo-cæcal form, and is very rare in the small gut. It is most common in adult males between the ages of twenty and forty, and the determining cause is not infrequently an epitheliomatous growth of the bowel which causes irritation and excites irregular peristalsis. Adhesions at the neck of the intussusception are constantly present and are often very dense, offering an insuperable bar to reduction. The intussusceptum rarely sloughs, since the interference with the circulation is gradual and not very great; spontaneous cure is consequently extremely rare. The layers of bowel forming the intussusception are thickened by chronic inflammation, and if epithelioma be present by extension of the growth. The bowel above is dilated and hypertrophied and the mucous membrane is the seat of stercoral ulcers.

Symptoms.—At first the symptoms are often of such an equivocal nature that a certain diagnosis is not arrived at. The onset is usually gradual—chronic dyspepsia, periodic pain, and a fluctuating state of the bowels being the leading features. In some cases there is constipation, in others diarrhœa with bloody mucus, or the evacuations may be nearly normal. Vomiting may or may not be present. The abdominal wall is flaccid, but there is some distension, and a tumour may be detected in about 50 per cent of the cases. The peristaltic movements of the hypertrophied gut may be plainly visible. As the case progresses the symptoms become more constant and less irregular in their manifestations. The patient loses health, strength, and appetite, and gradually dies from exhaustion, perforation, or acute obstruction caused by blocking of the narrow lumen with fæcal matter or undigested food. Unless relieved by surgery, chronic intussusception is certainly fatal in from six weeks to as many months.

Treatment.—The utmost care must be taken in dieting the patient, all indigestible substances and those leaving much solid residue being rigorously prohibited. The bowels may be kept acting by the use of laxatives, but strong purgatives must not be given. Pain may necessitate the use of morphia. The only curative measure consists of early laparotomy before the patient's strength and health have been seriously undermined. A careful attempt may be made to effect reduction, but for the reasons already given failure is to be anticipated. The alternative measures are resection, short-circuiting, or colotomy, the first being given the preference if the patient's condition permits of the operation.

STRICTURE OF THE INTESTINE

Narrowing of the intestinal canal may be due to inflammatory or cancerous changes in the wall, or the lumen may be diminished by the contraction of surrounding peritoneal adhesions. Inflammatory strictures are usually situated in the rectum or sigmoid flexure and are due to cicatrisation of dysenteric ulcers (p. 485). Typhoid and tubercular ulcers, owing to the direction of the former and the usually limited extent of the latter, rarely lead to stenosis. Syphilis sometimes causes great narrowing of the lower end of the rectum but very rarely affects the gut above this part (p. 485).

The form of cancer met with in the wall of the gut is columnar epithelioma. The growth is nearly always single and affects some part of the great intestine. Cancer of the bowel may also produce obstruction by causing volvulus or intussusception.

Morbid anatomy.—In a large proportion of cases the gut is strictured below the splenic flexure; when the small intestine is the seat of the disease it is usually in the lower end of the ileum. Cicatricial strictures are often of considerable extent, and the lumen may be much twisted on account of unequal contraction in different parts of the segment involved. Cancerous strictures are more regular, the new growth completely surrounding the wall for a short distance; the cancerous growth has a rounded, raised, and everted edge, and the general surface is ulcerated. At the seat of stricture, especially if it be cancerous, the gut may be fixed to surrounding parts by peritoneal adhesions which, should suppuration occur, confine the pus so that a large abscess sac is formed; this may communicate with the bowel and, bursting externally, may produce an artificial anus. Suppuration is rare except in cancerous cases. With progressive growth the cancer may become adherent to and invade the wall of a neighbouring coil of gut, or of the bladder, uterus, or vagina, the detection of fæcal matter escaping through these channels being diagnostic of the fistula. The degree of narrowing of the lumen varies very much; in some cases it is so slight that it causes but little trouble, in others the symptoms are more marked but are unaccompanied by anything like obstruction, while in the worst cases the passage through the stricture is so small that it readily becomes blocked with small scybalous masses or undigested food and acute obstruction is produced. The gut above the stricture hypertrophies in response to the demand for increased propulsive power; this being deficient, dilatation ensues, and in consequence of the retention of fæcal masses above the

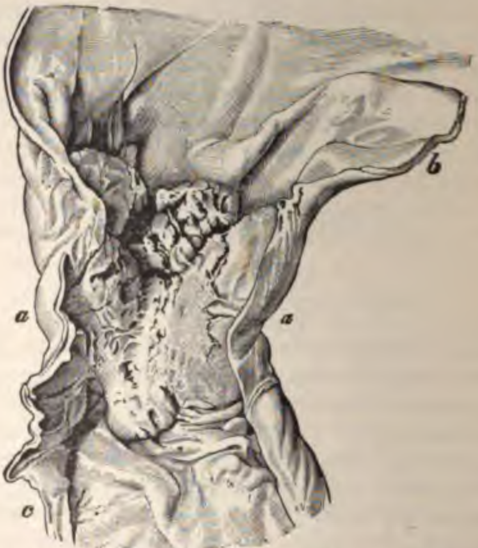

FIG. 124.—Cancer of the hepatic flexure of the colon (Ziegler). *a*, cancerous area; *b*, colon above, and *c*, colon below, the cancer.

stricture stercoral ulceration of the mucous membrane is common. Such ulcerated areas may lead to perforation resulting in acute peritonitis or local abscess according to circumstances.

History and symptoms.—Stricture of the gut is more common in males than females, and rarely occurs before forty years of age. There may be a distinct history of dysentery or ulceration, but it by no means follows that in such cases the stricture is inflammatory, since cancer not infrequently originates in a cicatrix. A history of chronic constipation, alternating with diarrhœa, dyspepsia, and abdominal uneasiness, is as common as in other forms of chronic obstruction. Sometimes an acute attack of obstruction, due to plugging of the lumen, is the first indication of the mischief, but careful inquiry usually elicits evidence of trouble extending over some months. The history will show that during this period the patient has had attacks of colicky pain radiating over the abdomen, but being more intense at the umbilicus, vomiting and distension after food, and increasing difficulty in obtaining an action of the bowels. Such attacks, which the patient usually describes as indigestion, may, during the early part of the trouble, be separated by considerable intervals. As the stricture becomes tighter they are more frequent and severe, partaking of the nature of subacute temporary obstruction, and finally culminating in the acute form, with stercoraceous vomiting and the other diagnostic features. These attacks are often brought on by food, especially if a meal has been heavy and large. Attacks of so-called "indigestion" are less common when the obstruction is in the large intestine than when it is higher up, and the vomiting is much less severe. Stricture of the small intestine does not produce symptoms so early as that of the colon because the contents, being fluid, pass more readily through a narrow aperture. The solid contents of the colon may be altered in shape when passed, provided the obstruction be situated in it; they are either narrow, flattened, and tape-like, or in small scybalous masses. If the obstruction is high up in the colon, this alteration in shape may not be present, since the fæces are remoulded below it. When the stricture is low down, and especially if it be cancerous, blood and mucus may be passed with the fæces, and there is considerable tenesmus. In all cases of stricture the abdomen is considerably distended, borborygmi are troublesome, and the hypertrophied coils of gut may be plainly seen during peristalsis. In cancerous cases a tumour may be felt, but its absence proves nothing. Examination by the rectum should always be made, and if it be found greatly distended stricture of the colon should be suspected. This condition of "ballooning" of the rectum appears to be due to partial paralysis of the gut below the point of stricture. In all cases the impairment of the general health is marked; the appetite is bad, and emaciation and exhaustion are speedily induced, partly on account of pain, but chiefly from deficient digestive power and imperfect action of the bowels.

Prognosis.—Stricture of the intestine is usually fatal within six months of its detection, death being due to gradual exhaustion, acute obstruction, or rupture of the gut above. In cases of inflammatory stricture surgery may indefinitely postpone the fatal termination.

Treatment.—The diet must be carefully regulated and selected, and the food should be given frequently and in small quantities. Milk, soups, pounded meat and fish, jellies, eggs, and similar food may be given, but all articles of diet leaving much waste material to be voided by the bowels must be rigidly excluded. Many acute and fatal attacks of obstruction have been caused by impaction at the stenosed spot of a mass of undigested food after a too hearty and ill-chosen meal.

The bowels must be kept acting by the use of mild aperients such as the confection of senna or some similar preparation. The use of strong purgatives is to be condemned, as the violent peristalsis set up causes considerable pain and may determine rupture of the gut above the obstruction, if its walls have been thinned by stercoral ulceration.

The advisability of any operation and its nature must be determined by the probable cause of the stricture, the urgency of the symptoms, and the benefit likely to be derived. If it seems probable that the stenosis is due merely to contraction of old peritoneal adhesions it may be permanently cured by their division, but in cases of mechanical occlusion by a cicatricial band or cancerous growth in the wall some more formidable procedure is necessary. From the very nature of the cause a curative operation, viz. resection, is to be favoured in cases of simple stricture, whereas it is but seldom advisable in the cancerous (unfortunately by far the most common) variety. Resection of the gut for cancer cannot offer much hope of cure until we are able to arrive quite early at an accurate diagnosis, for the disease quickly spreads to the lymphatic glands, and is so extensive (although apparently limited to the bowel) that the operation of resection has up to the present time proved most unsatisfactory. If resection be not advisable, but the symptoms demand some operation for their relief, the choice lies between short-circuiting the gut and the establishment of an artificial anus, both operations being, of course, palliative only. Short-circuiting is the more dangerous procedure, but has the great advantage of avoiding the unspeakable inconvenience of an artificial anus. If colotomy is contemplated, the exact seat of the obstruction must, if necessary, be diagnosed by exploratory incision.

In deciding between these various operations, it is but fair to place the whole matter, without reserve, before the patient or his friends, pointing out candidly the relative risks, advantages, and disadvantages, and consulting them as to their wishes. In giving advice under such circumstances, it may be well to bear in mind that the formation of an artificial anus, short-circuiting and resection are safe in the order given, but that the last only offers a chance—and that a very slender one—of permanent cure. Where the prolongation of a man's life, for even only a few weeks, is a matter of the greatest importance, few surgeons would hesitate in electing to perform colotomy rather than any of the other operations.

IMPACTION OF GALL-STONES, ENTEROLITHS, AND FOREIGN BODIES

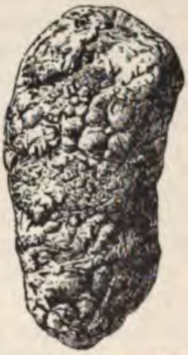

Fig. 125.—A gall-stone (reduced in size) which caused acute obstruction by impaction in the lower end of the ileum, necessitating enterotomy (Westminster Hospital Museum, No. 469. Drawn by C. H. Freeman).

Gall-stones which have entered the duodenum, through a fistulous communication between it and the gall-bladder, may become arrested in the lower ileum, and, very rarely, at the junction of the duodenum and jejunum. The formation of such a fistula may give rise to no symptoms, or only to such vague ones that the real nature of the case remains undiagnosed; nor is there necessarily any history of jaundice or hepatic colic. I removed the stone figured from the ileum of a woman who was seized with acute obstruction—the first illness she had ever experienced—and there was absolutely no history of gall-stones. When a gall-stone has passed into the gut in the manner described, it may cause considerable colic, perhaps recurring in paroxysms at long intervals, the stone failing to pass the ileo-cæcal valve. In many cases the stone passes during one of these attacks, and the patient is permanently relieved. If the stone remains long in the gut it may increase in size by the accumulation of fæcal matter on it.

Impaction of a gall-stone may lead to sudden acute obstruction, accompanied by the most profuse vomiting, or may cause chronic symptoms resembling those produced by stricture of the intestine, the patient, unless relieved by operation, dying from gradual emaciation and exhaustion.

Gall-stones have occasionally been extruded by ulceration of the gut, and the formation of an abscess bursting externally.

Intestinal concretions may be composed of salts of lime and magnesia, or of masses of undigested food, such as vegetable-fibre, husks of grain, etc. Oatmeal eaters are said to be peculiarly liable to this form of "stone." Large hair-balls are often found in the stomachs, and sometimes pass into the intestines, of cattle and other animals. Horses are very liable to intestinal concretions of various salts, which may weigh many pounds.

I have seen subacute obstruction caused by dense masses of tea leaves, which were eventually evacuated naturally; and also a case of fatal acute obstruction dependent upon enormous masses of string which the patient, a girl, had been in the habit of chewing. Intestinal concretions and foreign bodies rarely cause obstruction, as they usually lodge in the cæcum. Small foreign bodies as a cause of appendicitis have been mentioned at p. 390.

Impacted enteroliths and foreign bodies may cause ulceration and perforation. In rare cases they escape from the bowel at its mesenteric attachment, and become embedded in dense laminæ of fibrous tissue, the result of chronic inflammation.

Treatment.—The attacks of pain accompanying the lodgment of a foreign body or gall-stone may be subdued by opium, and the passage of the obstructing agent aided by mild purgation, provided the obstruction is only partial and not acute; but these should be carefully administered, unless the diagnosis is certain.

If an acute obstructive attack occurs, threatening the patient's life, laparotomy must be performed, and the stone removed by a linear incision (see p. 431).

A stone so tightly impacted as to cause acute obstruction cannot be pushed on without fear of damaging the distended gut above it. In some cases a gall-stone has been successfully broken up by needling through the wall of the gut, and this procedure may be tried if the condition of the gut and the size of the stone offer a chance of its success with safety.

FÆCAL IMPACTION

Causes.—Chronic constipation, leading to fæcal accumulation and obstruction, is most common in middle-aged women, especially such as are of naturally indolent habits. Constipation is very often hereditary, and met with in many members of the same family. Defective innervation and feebleness of the muscular coat of the colon are the chief causes, both of which are accentuated by chronic over-distension. In some cases the wall of the colon is so thin that it consists of peritoneum and atrophied mucous membrane only, with here and there a mere trace of muscular tissue. In one such case I was forced to make an artificial anus with the lower end of the ileum. When peristaltic action is very feeble, a portion of the gut may be almost completely paralysed (*ileus paralyticus*), and fæces cannot pass along it. Chronic constipation may also be dependent on want of moisture, and hence great dryness of the fæces, with consequent difficulty of passage; or again, the sensibility of the rectum may be so slight that the necessary stimulus to the defæcation centre is insufficient. No doubt personal indolence and neglect are in great measure responsible for the aggravation of a condition to which the patient is naturally predisposed.

Symptoms.—There is always a history of long-continued constipation, with attacks of spurious and sometimes profuse diarrhœa, accompanied by a mucous or muco-bloody discharge, due to catarrh of the mucous membrane excited by the retained fæces. There is abdominal uneasiness with distension and flatulent dyspepsia, the appetite is bad, and the general health deteriorates. The patient suffers from frequent headaches, and irritability of temper is sometimes marked. Periodic attacks of colic, with flatulence and vomiting, become more and more frequent and severe, and may eventually terminate in definite subacute or even acute obstruction, which may prove fatal. The signs of fæcal impaction may extend over many weeks, during which there has never been any satisfactory action of the bowels. Abdominal examination reveals the presence of the fæcal tumour in the cæcum and along the colon; it is usually cylindrical, and pits on pressure, having a doughy feeling, except in the lower part of the colon, where the scybalous masses may be clearly felt, but are of such hardness that no impression can be made on them. Fæcal masses in the transverse colon may, by their weight, displace it downwards towards the pubes, and when the sigmoid is distended volvulus may occur. Stercoral ulcers in the cæcum may be a source of considerable danger owing to the possibility of perforation and general peritonitis. Examination of the rectum will in most cases reveal a large accumulation of scybalous masses.

Treatment.—The treatment of chronic constipation consists essentially in careful regulation of the diet and bowels, the use of laxatives as occasion may require, the employment of gentle daily massage and kneading of the colon, combined with the use of electricity. A pill of iron, aloes, and belladonna is most useful in such cases. The iron gives tone to the feeble muscular tissue, while aloes increases peristalsis and the moisture of the mucous canal, the belladonna obviating colicky pains.

Recently it has been suggested to stretch the sphincter ani in chronic cases; and in one such case under my care, in which the operation was required for another cause, the effect has been most beneficial.

If accumulation actually occurs, an attempt must be made to clear the bowel by the use of large enemata of soap and water, or of warm olive and castor oil, coupled with the administration of an aloetic purge. Violent purgation is to be avoided. At the same time, the abdomen may be kneaded and peristalsis excited by the Faradic current, the positive pole being placed in the rectum and the negative over the colon. If it is impossible to remove the obstruction by this means, the patient must be anæsthetised, the anus fully dilated, and the rectum emptied by the scoop, enemata then being employed to clear the colon. If signs of acute or subacute obstruction supervene, with much flatulent distension, the gut may be freely punctured through the abdominal wall, while every effort is made by the means stated to procure evacuation of the scybalæ.

OBSTRUCTION DUE TO COMPRESSION FROM WITHOUT

Ovarian tumours wedged in the pelvic cavity, and other abdominal growths, may cause subacute or chronic obstruction by pressure. I have seen complete obstruction gradually produced by a large pelvic hæmatocele, colotomy being rendered necessary in consequence.

Obstruction from external pressure is usually met with in the rectum, sigmoid flexure, or end of the ileum, since these parts, lying in the pelvis, are more or less fixed and unable to slip aside.

The diagnosis is in most cases easy, the compressing tumour being readily detected. The treatment consists in careful dieting, and the administration of mild laxatives, or the use of enemata. If the obstruction is subacute or acute, colotomy may be performed, preferably in the iliac region; but if the tumour causing the obstruction can be safely removed, this should, of course, be done.

Peritoneal adhesions may surround a portion of gut, or may drag upon it and cause kinking; in such cases the symptoms are those of stricture. Division of the bands effects a permanent cure.

OPERATIONS ON THE INTESTINES

RESECTION OF THE INTESTINE—ENTERECTOMY AND COLECTOMY

Resection of the bowel may be required in consequence of injury or gangrene, for the cure of artificial anus or for the removal of a cancerous or fibrous stricture, and in some cases of intussusception. The operation is always formidable, but the danger necessarily varies with the actual cause for which it is undertaken, the general condition of the patient, the method employed for the subsequent union of the divided bowel, which shortens or prolongs the operation, and thus influences the subsequent shock; and, lastly, with the operative dexterity of the surgeon.

The abdominal incision should, when possible, be exactly over the portion of bowel to be removed; but if this cannot be ascertained, the abdomen should be opened by a median incision just below the umbilicus (*i.e.* opposite the mesenteric attachment), and when the seat of the disease has thus been ascertained, a second opening may be made in the more correct position if necessary. When the bowel has been exposed, the portion to be removed is drawn out of the wound by traction on its mesentery, and must be carefully isolated by warm, flat sponges, so that the abdominal cavity is completely shut off. The loop is now emptied of its contents by gentle pressure in an upward and downward direction, and the bowel is clamped above and below the seat of operation. For this purpose Makin's clamp is one of the best instruments.

The gut is divided with a sharp pair of blunt-ended scissors in a rather oblique direction, more being taken from the free than from the mesenteric side. A triangular piece of mesentery should also be removed, but care must be taken that the mesentery is not detached from the portions of bowel above and below the points of section of the gut, otherwise the vascular supply will be endangered. Irrigation with warm sterilised water should be employed to wash away any foul material. Bleeding vessels must be caught in fine pointed forceps, care being taken that the coats of the bowel are not also included and thus bruised. The divided mesentery is now accurately united by sutures of fine silk or chromic gut, and the divided ends of the bowel are united by one or other of the methods to be presently described. Resection and subsequent union of the divided ends may be undertaken in three stages, as strongly advocated by Greig Smith. The first step consists in fixing the loop of bowel outside the abdomen by means of one or two glass rods passed through the mesentery and resting on the abdominal wall. No sutures are required. The gut is then opened above the obstruction, and a full-sized drainage tube is introduced into it, and kept in position by a safety pin passed through the gut and tube; the latter is then connected with two or three feet of tubing, which will convey the contents of the bowel into a receptacle by the side of the bed. The loop of bowel is covered with a piece of oiled silk, outside which an antiseptic dressing is applied.

The second stage may be undertaken in about ten days, and consists in removing the prolapsed loop, with a pair of scissors, flush with the abdominal wall. The bowel is by this time adherent to the wound, and will not slip back into the abdomen.

The third stage consists in closing the artificial anus formed by the above means by enterorrhaphy, and should be undertaken when the general condition of the patient is satisfactory (p. 437).

ENTERORRHAPHY

The union of two portions of bowel may be accomplished by suturing alone (*direct method*), or by suturing with the use of some mechanical apparatus (*mediate method*). Union by the direct method is, as a rule, not to be recommended in view of the length of time occupied in the operation and the consequent severity of the shock, with probable fatal consequences which it entails, for whatever theoretical objections may be urged against the use of mechanical contrivances to effect union, clinical experience amply proves that such objections are of no great weight.

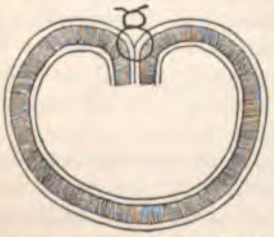

FIG. 126.—Lembert's suture passing through the serous and muscular coats of the bowel.

Sutures and needles.—The best material for suturing is undoubtedly fine Chinese twist, rendered aseptic by boiling. Ordinary sewing needles about size No. 8 will be found the most convenient; they should not be too sharp, so that the danger of penetrating the mucous coat is, with ordinary care, reduced to a minimum; and, moreover, a blunt needle is more likely to push aside any vessel that it may encounter instead of wounding it.

Method of suturing.—The sutures should not penetrate the mucous coat, but should pick up the submucosa, so that they obtain a secure hold on the wall of the bowel. Numerous methods of suturing have been devised; of these Lembert's, the Czerny-Lembert, and Halsted's are for general purposes the best for interrupted sutures; for continuous suturing Dupuytren's method answers well. The method of introducing the various sutures will be more readily understood by a reference to the accompanying figures than by description.

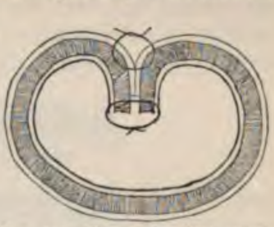

FIG. 127.—Czerny-Lembert suture. One suture unites the mucous membrane, the other only passes through the serous and muscular coats.

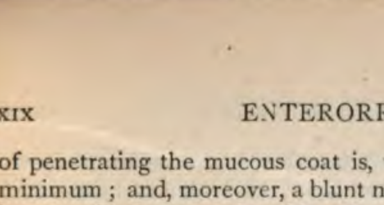

FIG. 128.—Halsted's quilt suture.

Mechanical apparatus.—Of the numerous contrivances which have been devised as aids in the performance of enterorrhaphy, those of decalcified bone and Murphy's button are to be especially mentioned. Paul's bone tubes, Mayo Robson's bobbins, and Senn's plates appear to be the best forms of decalcified bone apparatus.

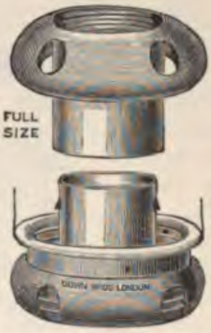

FIG. 129.—Murphy's button. The lower figure is the male half which has a spring flange for keeping up pressure as atrophy of the included margins of bowel proceeds (Messrs. Down Bros.).

Murphy's buttons are made of various shapes and sizes according to the portion of bowel to be operated on. Their use undoubtedly shortens the operation, since but little suturing is required; moreover, as contrasted with other methods of effecting union the approximation is more complete, the bowel is less manipulated, subsequent rest is not so important, and the patient may therefore be fed more generously and the bowels acted on earlier. The infolded portions of the bowel, approximated and compressed between the two halves of the button, undergo pressure necrosis, and the button falls into the intestinal canal, and is passed *per rectum*.

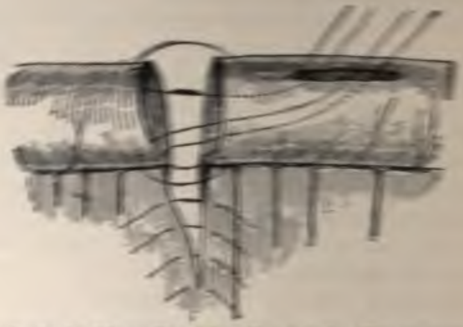

FIG. 130.—Enterorrhaphy by Maunsell's method (first stage). The segment of bowel and a V-shaped piece of mesentery has been removed; the sutures for uniting the divided mesentery are *in situ*; the traction sutures have been passed through the divided ends of the bowel, one on the mesenteric side, and the other on the convex side; the ends of these sutures are passed through the lumen of the lower end of the bowel and out through an incision on its convex margin (Waring, *Manual of Operative Surgery*).

It occasionally happens that the necrosis extends beyond the necessary limits and perforation of the bowel with peritonitis results.

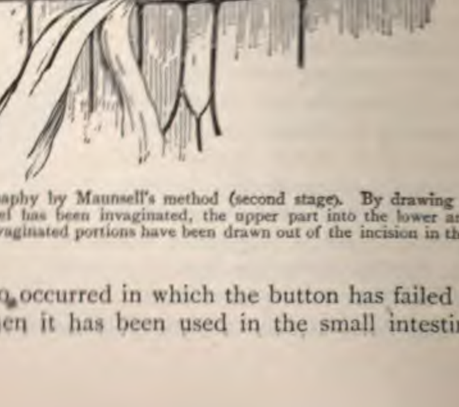

FIG. 131.—Enterorrhaphy by Maunsell's method (second stage). By drawing on the traction sutures the bowel has been invaginated, the upper part into the lower and the latter on itself, and the invaginated portions have been drawn out of the incision in the lower segment (Waring).

Cases have also occurred in which the button has failed to pass the cæcal valve when it has been used in the small intestine, but the probability of such an accident occurring is by no means as great as might be supposed.

Varieties of operation.—The bowel may be united by end-to-end approximation, by end-to-side or implantation, or by side-to-side or lateral anastomosis.

END-TO-END APPROXIMATION

Maunsell's method by direct suture.—The bowel being clamped about five inches distant from the cut ends, these are loosely united by a suture passing through all the coats at the mesenteric and free sides (Fig. 130), the ends of these sutures are left long, and are used to produce the subsequent invagination of the upper into the lower portion of bowel. The lower end of the bowel is now incised for about one and a half inch along the free border, the incision beginning two inches from the cut end. Through this incision the ends of the two sutures are drawn from within the bowel, and by traction on them the gut is invaginated and the invagination is drawn out of the incision, where it will appear as two complete tubes, one inside the other, the peritoneal surfaces being in contact (Fig. 131). The invagination is now completely transfixed by suturing in about ten places, the sutures are divided, and thus twenty result, which on being tied accurately unite the two portions of gut. The temporary traction sutures are cut short, the invagination is reduced, and the linear cut in the lower segment of bowel closed by a double row of Lembert's sutures (Fig. 132). For greater security a few points of Lembert's suture may with advantage be inserted round the line of union of the two portions of bowel.

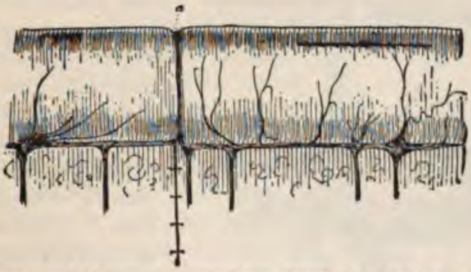

FIG. 132.—Enterorrhaphy by Maunsell's method (completed). The divided ends of the segments have been united by interrupted sutures passing through all the coats; the invagination has been reduced and the longitudinal incision in the bowel has been united by Lembert's sutures, and those uniting the divided mesentery have been tied. The approximation will be rendered safer and more complete by a few points of Lembert's suture at the line of union (*a*), (Waring).

Paul's mediate method by bone tubes.—The bone tube with a traction thread attached (Fig. 133, *A*) is placed in the upper end of bowel, and fixed by a continuous suture passing through the cut margin. The traction thread on a needle is passed along the lumen of the lower segment of bowel and brought out through the wall about three inches from the cut end (Fig. 133, *B*). The cut ends of the segments are now united by a continuous suture, and the upper segment is invaginated into the lower by an assistant drawing on the traction thread (Fig. 133, *C*). Lembert's sutures are employed to fix the invagination. The traction thread is drawn tight and cut short, the ends dropping into the bowel.

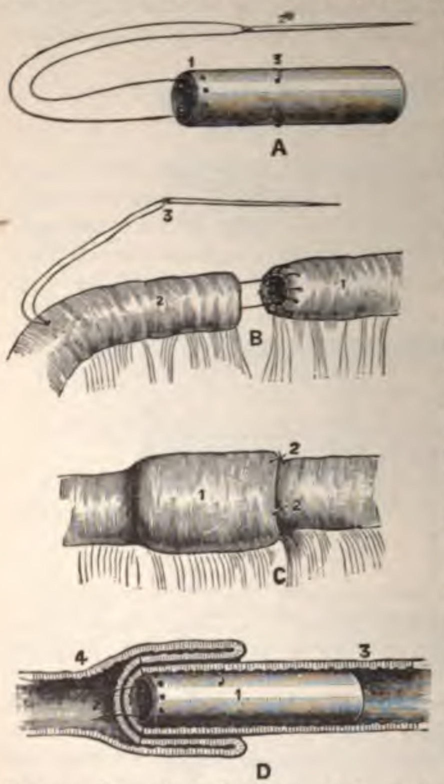

FIG. 133.—Enterorrhaphy by Paul's method. *A*, the decalcified bone tube; 1, the distal end perforated for sewing to the bowel; 2, the traction thread armed with long sewing needle; 3, its attachment to the tube. *B*, a stage in the operation; 1, the proximal end of the bowel with the tube sewn in; 2, the distal end not yet sewn to the proximal, but with the traction thread, 3, passed. *C*, the operation completed; 1, the sheath or intussuscipiens of the invagination; 2, the Lembert sutures for retaining the parts in position. *D*, the parts dissected; 1, the tube *in situ*; 2, the traction thread cut short; 3, the proximal end of the bowel entering the intussusception; 4, the distal end forming the returning and ensheathing layers (Greig Smith).

Murphy's mediate method by a metal button. — A running thread is passed by a stop stitch along the cut edge of the bowel (Fig. 134). This stitch is called the purse string or puckering thread, and is begun and ends at the free border of the gut; at the mesenteric attachment a return over-stitch is made so that the peritoneal surfaces are brought into accurate apposition. One half of the button held in forceps (Figs. 135, 136, p. 430) is now placed within the bowel and is fixed in position by drawing tight and tying the puckering thread round the central cylinder (Fig. 137, p. 431). The other end of the bowel is similarly treated, and the operation finished by pressing together the two halves of the button.

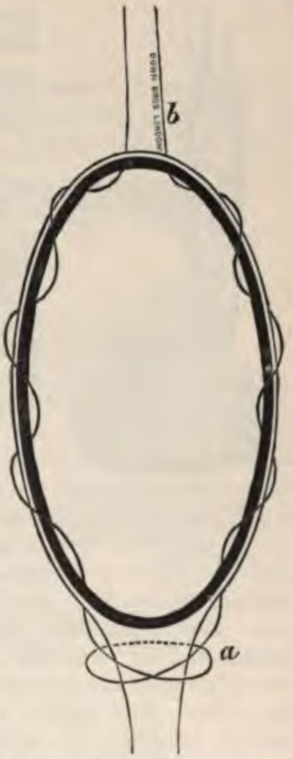

FIG. 134.—End-to-end approximation with Murphy's button. A top stitch is carried along the cut margin beginning at the convex side of the gut (*b*); at the mesenteric attachment a return over-stitch is made and the top stitch is then continued along the other side to the convexity again. This constitutes the "puckering stitch," which, when tied round the half of the button after its insertion, draws the cut edge of the bowel within the clasp (Fig. 137, p. 431), (Messrs. Down Bros.).

This method has the great advantage of occupying a very short time.

END-TO-SIDE UNION OR IMPLANTATION

Union of the end of the upper segment of bowel to the side of the lower is especially applicable when the ileum has to be joined to the colon. The operation may be quickly performed by the use of **Murphy's button,** which is inserted into the cut end of the upper segment as described in end-to-end approximation, and into the lower segment as in cases of lateral anastomosis (see below). The cut end of the lower segment of bowel is invaginated and closed by a double row of Lembert's sutures, or by a continuous suture first, and a single row of Lembert's to make all secure.

Maunsell's method as described for end-to-end approximation may also be employed, the cut end of the lower segment of bowel being used to draw the invagination through and closed when the implantation has been effected.

SIDE-TO-SIDE UNION—LATERAL ANASTOMOSIS—SHORT-CIRCUITING THE BOWEL

Lateral approximation may be effected after removal of a segment of bowel and closure of the cut ends by a continuous suture re-enforced by a single row of Lembert's, or it may be performed without removal of any bowel, the part above the obstruction being approximated to the part below (*short-circuiting*).

Approximation by suture is not to be recommended, since it occupies a long time and has no special advantages.

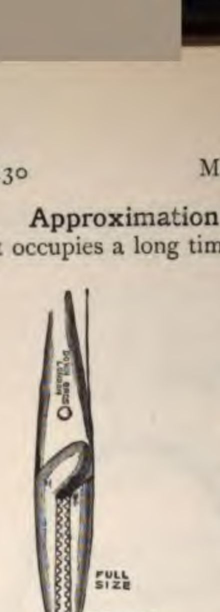

FIG. 135.—The method of holding the female half of the button ready for insertion into the bowel (Messrs. Down Bros.).

Senn's mediate method by bone plates.—If a portion of bowel has been removed each end is invaginated, so that peritoneum is opposed to peritoneum all round, and is then closed by a continuous suture passing as deep as the submucous coat re-enforced by a single row of Lembert's sutures. An incision about one inch long is now made in the free border of each end of the gut, about two inches beyond the occluded end, and through this a properly threaded bone plate is introduced into the bowel. The middle sutures are passed through all the coats of the bowel about an eighth of an inch, or rather more, from the cut margin; the end sutures do not pass through the intestinal wall. The peritoneal surfaces are now gently scarified, and the bowel is approximated by tying the four sutures from one plate with the corresponding ones from the other. The sutures are cut short and buried between the approximated serous surfaces. Approximation is finally rendered more secure by a continuous suture at the level of the margins of the bone plates, and an omental graft may be added if thought necessary.

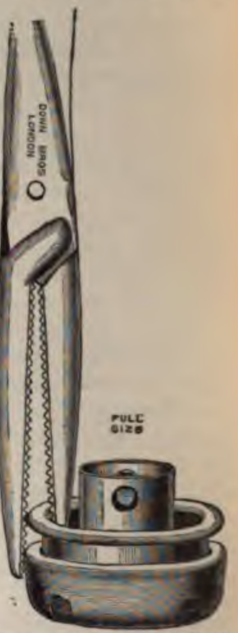

FIG. 136.—The method of holding the male half of the button ready for insertion into the bowel (Messrs. Down Bros.).

Murphy's button enables the operation to be very quickly performed. A running thread is passed through all the coats of the bowel (Fig. 138), and the gut is incised within the limits of the suture. One half of the button is introduced and fixed in position by drawing the thread tight and tying it round the central cylinder of the button. The other portion of bowel is similarly treated, and the operation finished by closing the two halves of the button (Fig. 119, p. 375).

LINEAR ENTEROTOMY

This operation may be required for the removal of an impacted foreign body, or to allow the escape of the contents of the gut in cases of distension either from obstruction or acute septic peritonitis.

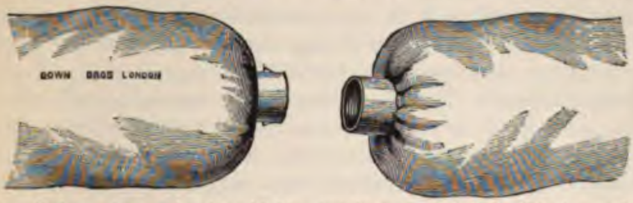

FIG. 137.—End-to-end approximation with Murphy's button. Each half of the button is in the bowel and the puckering strings have been tightened; it only remains to press the two halves of the button together (Messrs. Down Bros.).

The coil of bowel is drawn up and the peritoneal cavity shut off by warm, flat sponges.

An incision of sufficient length is made opposite the mesenteric attachment, the gut, in the case of removal of a foreign body, being clamped on each side. Warm irrigation should be employed, and, if the state of the patient admits, the wound should be closed with a double row of Lembert's sutures extending a third of an inch beyond each end of the incision. If the patient's condition is serious the time occupied in suturing may materially add to his danger; under such circumstances a temporary artificial anus should be formed, and dealt with when the patient has regained his strength.

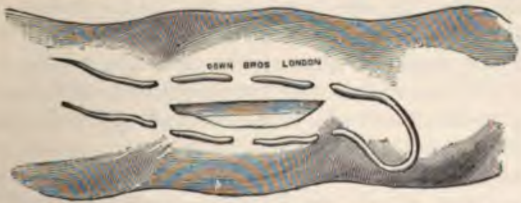

FIG. 138.—Lateral and end-to-side approximation with Murphy's button. The "running thread" is inserted through all the coats of the bowel so that a loop is formed within which the gut is incised. The half of the button is then introduced and the running thread is drawn tight so that the cut margin is drawn within the grasp of the button (Messrs. Down Bros.).

ENTEROTOMY—COLOTOMY

The formation of an artificial anus with the small intestine (*enterotomy*) or colon (*colotomy*) may be required when no other operation is admissible, or when the serious condition of the patient does not permit of such operation being undertaken (see p. 418). An artificial anus is also sometimes formed as a purely temporary measure when the obstruction is of such a nature that it can in time be overcome, as in the case due to pelvic hæmatocele quoted on p. 422. When the seat of the obstruction is high up in the small intestine, the establishment of an artificial anus would certainly prove fatal, and is therefore unjustifiable.

Enterotomy.—This operation being merely a palliative procedure, is often done in the most convenient position without a previous laparotomy; but should this have been performed as an exploratory measure the artificial anus may be made in the middle line. If no laparotomy has been performed, the abdomen is opened by an incision about two inches long, the centre of which bisects a line drawn from the umbilicus to the anterior superior iliac spine. This incision may be made on either side, but is usually done on the right, so that the lowest coil of the ileum may be taken. A distended coil of gut will now present in the wound, and should be attached to peritoneum and skin in the manner to be described under Littré's operation. If relief is not urgently called for, the bowel should not be incised for twelve or twenty-four hours; but if delay is dangerous, a trocar and canula may be used to draw off the contents of the bowel, the margins of the wound being well smeared with carbolised vaseline to prevent, as far as possible, contamination of the peritoneum.

The after-treatment is discussed at p. 435.

Colotomy may be performed through the loin by Amussat's method or anteriorly in the iliac region as practised by Littré. Both operations are usually done on the left side. Most surgeons prefer the anterior operation, when there is any choice, for the following reasons:—It is more easily performed; it places the artificial anus in a more convenient position for the patient; and, moreover, allows the surgeon the opportunity of examining the abdominal cavity. The danger from opening the peritoneum is very slight if due cleanliness be observed.

Inguinal colotomy—Littré's operation.—An incision from two to three inches long is made one and a half inches from the anterior superior iliac spine, the centre crossing a line drawn from this point to the umbilicus (Fig. 19, *c*, p. 84). The structures in the abdominal wall are carefully divided and the peritoneum opened. A flat sponge is now introduced, and the peritoneum and skin are united by a few chromic gut sutures. The small intestine is pushed aside, and the colon, easily recognised by the longitudinal bands of muscular fibres and appendices epiploicæ, sought for. The gut is gently pulled down, so that it may be attached as high up as possible, and united to the peritoneum and skin by fine carbolised silk. It is important to draw the gut well forward so that a good "spur" may be formed; for, unless this be ensured, fæces will pass into the lower part of the bowel and cause much subsequent trouble. The peritoneal and muscular coats of the gut are now held between the finger and thumb—the mucous coat being excluded by a slight gliding motion of the fingers—and the sutures of fine carbolised silk are passed through these coats, and then through the parietal peritoneum and skin. The sutures should be about an eighth of an inch apart, and great care should be taken to get good apposition at the angles of the incision. A guiding stitch to facilitate the second stage of the operation is passed through the centre of the exposed bowel, taking up the peritoneum and muscular coats only. If the symptoms permit of delay, an antiseptic dressing is applied and the gut left unopened until the end of two or three days, when it may be opened with scissors or a sharp knife, the guiding stitch being slightly drawn upon to render the wall of the gut tense. Any vessels which may bleed may be twisted, but this is rarely necessary.

Neither the method of passing a suture through the mesentery on each side and then through the sides of the abdominal wall near the lower end, nor that of drawing the gut to the surface by placing a glass tube through the mesentery, appear to offer any advantages over simple suture, provided care be taken that the portion of gut to be fixed to the wall is drawn well forward, *i.e.* out of the wound in the parietes.

Lumbar colotomy (Calissen's and Amussat's operation).—Provided the seat of the obstruction permits, this operation should be performed on the left side, for the descending colon is less liable to abnormalities and less frequently surrounded by peritoneum than is the ascending. If, however, the actual seat of obstruction cannot be diagnosed, but is known to be in the colon, colotomy should be performed on the right side.

The patient is rolled over to the opposite side and a pillow or sand-bag placed beneath the loin in such a manner that the interval between the last rib and the iliac crest on the side of the operation is opened up to the fullest extent. An incision about four inches long is made parallel with the last rib and midway between it and the iliac crest, the hinder limit of the wound being at the outer edge of the erector spinæ. The colon is marked by a line drawn vertically upwards to the last rib from a point half an inch behind the centre of the crest of the ilium measured from the anterior to the posterior superior iliac spine. When the first muscular layer is exposed, the external oblique will be found in the anterior two-thirds of the wound and the latissimus dorsi behind it; these are divided, and the internal oblique is then seen in the whole length of the wound; this again is divided and the fascia lumborum and last dorsal nerve and artery are exposed and cut. The outer edge of the quadratus lumborum is now seen posteriorly and should be divided, if necessary, to give more room. A varying quantity of fat is now to be torn through with two pairs of forceps, the exposed transversalis fascia carefully but freely opened, and the bowel defined. The colon is recognised from peritoneum by its greater thickness and by the recognition of its contents. If the colon be distended, as will necessarily be the case when the operation is undertaken for the relief of obstruction, it is easily drawn up into the wound and secured. When the colon is collapsed, as it may be when the obstruction is only partial, it may be distended by insufflation *per rectum* by means of Lund's insufflator or an ordinary pair of bellows. The lower edge of the kidney is a useful guide to the bowel, which may also be made evident by an assistant pressing it up into the wound through the abdominal wall. In some cases the gut may be found by placing the index finger in the posterior part of the wound and rolling the patient on his back, the gut falling to the palmar aspect of the finger and being readily seized.

The colon is drawn well up into the wound and, if it be not necessary to open it at once, is secured *in situ* by passing two fine hare-lip pins through it an inch apart, their ends resting against the skin. Further security may be obtained by suturing the outer coats of the gut to the skin. The anterior part of the wound is now closed with silkworm gut and a dressing applied. The bowel may be opened on the third or fourth day.

If the urgency of the symptoms demands immediate relief, the operation is completed in the following way:—A stout semicircular needle threaded with silk is passed through the superficial part of the anterior end of the wound on one side, then through the gut, traversing it for about an inch, and through the wound at a corresponding point on the other side; a similar suture is passed about one inch behind the anterior one. These sutures being drawn tense, the gut is opened by an incision about an inch long, the raw surface of the wound having been first thoroughly dried and painted with a mixture of ether and iodoform, and every care taken that the fæcal matter does not foul the wound. The finger is now introduced into the bowel, the anterior thread is drawn out and divided, and the two sutures thus formed are tied; the posterior suture is similarly treated, and a few additional points of suture may, if necessary, be passed through the margins of the wound in the bowel, and unite it to the skin.

The anterior margin of the parietal wound should be united by a few points of suture. The surrounding skin must be plentifully smeared with iodo-vaseline, and a pad of oakum lightly applied and frequently changed as the bowel evacuates its contents.

Dangers and difficulties.—The peritoneum may be opened if the incision be made too far forward, if manipulation be too rough, or if, through its bulging into the wound, it be mistaken for the bowel. Should this accident happen the rent must be sutured, and the bowel fixed to the skin by sutures and on no account opened until the third or fourth day; for if the operation be completed in one stage, diffuse septic peritonitis with fatal results will most probably ensue.

The same plan of treatment is essential if the colon should be found to possess a meso-colon.

Failure to find the colon on the left side necessitates inguinal colotomy on the right, this operation being chosen in preference to the lumbar, because, if the cæcum cannot be found, a coil of distended gut may be opened. The causes of death after colotomy are shock and exhaustion if the operation has been too long delayed or prolonged on account of difficulties met with, peritonitis, or diffuse cellulitis which, extending from the wound, may spread widely.

The management of the artificial anus.—In cases of obstruction, it sometimes happens that within a few hours after enterotomy and evacuation of the contents of the bowel, the temperature rises and the patient exhibits all the symptoms of septic absorption; should this occur, the bowel should be thoroughly washed out and 10-grain doses of salol given night and morning. Every care must be taken to prevent excoriation of the skin, which is produced by the irritation excited by the fæcal matter, especially when the acrid contents of the small intestine escape. The use of salol materially lessens the irritating properties of the fæces, and the skin must be protected for some distance round the opening by a plentiful use of boracic ointment or vaseline. Charcoal (in powder or biscuits) is useful to diminish fœtor and render the fæces more solid. The bowel, especially the lower segment, should be washed out occasionally to guard against retention of fæcal matter which causes great inconvenience. The patient should be fitted with a colotomy truss, no form of which, however, is completely effective. If there is any tendency to contraction, a vulcanite plug may be worn, or the orifice dilated with sponge-tents. Prolapse of the mucous membrane is sometimes extensive and always annoying; it is especially liable to occur if the gut has not been well pulled up at the time of operation. The prolapsed portion must be reduced and kept in position by a broad and well-fitting pad.

ARTIFICIAL ANUS AND FÆCAL FISTULA

In artificial anus and fæcal fistula the gut opens on the surface. In the former the opening is large enough to permit the greater bulk of the intestinal contents to pass through it; in the latter it is so small that very little escape takes place.

Causes.—An artificial anus is usually intentionally made for the relief of obstruction, but fæcal fistula is generally the outcome of some pathological process. These conditions may follow gangrene of a strangulated hernia, or localised suppuration complicated by perforation of the gut in connection with cancer, tubercle, or chronic obstruction. In cases of cancer, intestinal fistulæ may form between the bladder, uterus, or vagina, and may cause so much annoyance that colotomy becomes necessary; if, however, such a fistula is formed with a coil of small intestine, an artificial opening can only be made after an examination by abdominal section, and even then the operation must only be undertaken if the implicated coil is low down. Umbilical fæcal fistula sometimes results from persistence of the vitello-intestinal duct.

Morbid anatomy.—The wall of the gut is adherent round the margin of the fistula, and hence extravasation into the peritoneal cavity is prevented. Sometimes an abscess cavity or sinus of considerable length may intervene between the external opening and the gut; in other cases, the coil of gut opening on to the surface communicates with a second or even a third coil. The size of the opening depends on the amount of destruction which has occurred, and the age of the fistula, which tends to contract with time. Fæcal fistulæ may have many small external openings with granulations projecting from their orifices, the channels being kept patent by the passage of fæces. In artificial anus, the wall of the gut which is not adherent to the parietes projects forwards towards the opening; the projecting portion is known as the *éperon* or spur, and serves to divert the fæces from the normal channel and through the external opening (Fig. 139, p. 438); hence it is the great bar to spontaneous cure. The upper part of the gut is hypertrophied and dilated owing to the narrowness and rigidity of the external orifice; its lower portion atrophies proportionally to its disuse. Spontaneous cure is not uncommon in fæcal fistula, but never occurs in artificial anus.

Results.—The effect upon the general health entailed by an artificial anus depends upon what portion of gut is involved. When the colon is implicated the health is not impaired, the patient being only troubled by the escape of fæces and gas; but if the small gut is affected, the health suffers proportionately to the height of the involved segment; artificial anus high up is speedily fatal. The continued escape of irritating fæcal material causes eczema and painful ulceration of the skin, unless great care be observed to protect the skin by the plentiful use of vaseline; and this is even more troublesome and extensive in fistulæ of the small intestine as the contents are acrid and fluid.

Treatment.—Fæcal fistulæ often heal if the parts be kept clean. Closure may be hastened by the application of a fine cautery point, or the edges may be pared, and the raw surfaces united by suture. The conditions attending the formation of an artificial anus, *e.g.* cancer, may negative any attempt at cure; but if this is advisable, and the local and general conditions of the patient are favourable, closure may be effected by resection, or by Dupuytren's operation.

Resection.—The bowels must be thoroughly emptied by aperients and flushing through the artificial opening, and the patient should be fed entirely by the rectum for two days before the operation. The margin of the wound is freshened and rendered thoroughly aseptic. An incision two or three inches long is made in the most convenient position, extending into one end of the artificial anus; the bowel is examined, freed of its adhesions, drawn up into the wound, and resected as described at p. 423. The abdominal wound should, if possible, be closed by sutures; if not, it must be plugged with gauze, and left to heal from the bottom.

Dupuytren's operation is less generally successful, but also less dangerous than resection. It consists in re-establishing the normal channel by obliterating the spur, and subsequently paring and suturing the margins of the opening in the parietes. The spur is caught between the blades of the enterotome, which is daily tightened, so that sloughing is occasioned. Care must be taken that the spur be not destroyed too quickly, else when it separates perforation into the abdominal cavity may result if adhesions be absent. The second stage of the operation should be performed as soon as it is clear that the fæces are passing by the natural channel. If it is determined not to attempt the cure of an artificial anus, the treatment is the same as after colotomy (see p. 435).

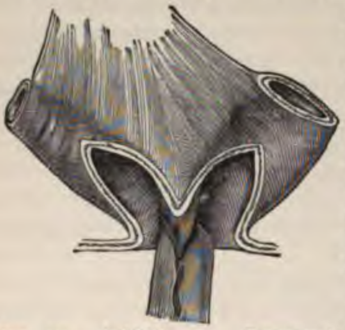

FIG. 139.—Artificial anus. Dupuytren's enterotome applied to the "spur" (Follin).

CHAPTER XX

HERNIA OF THE ABDOMEN

THE GENERAL ANATOMY OF HERNIA

A HERNIA is a protrusion of gut, omentum, or other abdominal contents through an opening in the wall. The protruded portion (called the contents) is enclosed by an investment of peritoneum—the sac—outside which are the coverings, *i.e.* the structures between it and the skin.

The sac.—The peritoneum over the aperture through which the hernia escapes is pushed outwards, and forms at first a depression with a wide circular mouth. As the hernia descends lower and increases in size, the peritoneum is still further pushed down and stretched so that it comes to resemble the finger of a glove, but when the tumour escapes from the restraint of the tendinous structures (*e.g.* the inguinal canal) among which it first passes, the sac expands in the loose cellular tissue and becomes rounded or flask-shaped, so that when fully formed it consists of a "fundus" and "body" communicating with the abdominal cavity by a usually narrow "neck."

As the neck passes through more or less resistant structures, the peritoneum is thrown into folds as a handkerchief would be if passed through a ring, and in consequence of irritation these folds become permanently matted together, so that at this part the peritoneum is thickened and rendered more unyielding than the rest of the sac, and this is increased by irritative overgrowth and condensation of the surrounding cellular tissue. In the case of children, this thickening of the neck and increase of fibrous tissue round it, in conjunction with a natural tendency to obliteration of the process, may, if the hernia be kept constantly up, result in gradual contraction, ultimate obliteration, and permanent cure; but, on the other hand, the resistance it occasions may cause strangulation if a portion of gut be forced down. The same process of irritative overgrowth affecting the body and fundus of the sac not only thickens the wall, which may be considerably stretched, but very soon causes the sac to become adherent to its coverings, and consequently irreducible, and it must be borne in mind that the terms reducible and irreducible hernia apply to the contents only and not to the sac, which is always irreducible. The thickening of the sac is specially noticeable in old herniæ.

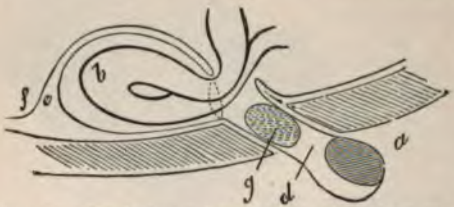

FIG. 140.—Hernia into a lateral prolongation of the sac, situated in the retro-peritoneal tissue (Follin). *a*, the testicle; *b*, protruded bowel; *d*, processus ad testem; *e*, retro-peritoneal tissue; *f*, parietal peritoneum; *g*, indicates the point to which the testis can be reduced.

In umbilical and ventral hernia the sac is often very thin, and its neck very wide.

The sac may, especially in umbilical herniæ, be pouched (Fig. 140), or being constricted at one part, is like an hour-glass in shape, a condition which may lead to the belief that a hernia has been reduced when it has only been pushed from the lower into the upper compartment of the sac (Fig. 141). Hour-glass sac is practically confined to inguinal herniæ.

Some herniæ, *e.g.* of the bladder, have only a partial sac, or it may be entirely absent; under such circumstances the protruded viscus speedily contracts adhesions to its coverings, and is thereby rendered irreducible.

The contents is most usually a lower coil of the ileum, but any portion of the intestinal canal may be prolapsed (*enterocele*). In strangulated femoral hernia, it sometimes happens that only a portion of the circumference of the bowel enters the sac (*Richter's hernia*). Meckel's diverticulum may alone descend into a hernial sac (*Littré's hernia*).

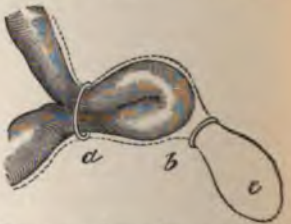

FIG. 141.—Incomplete reduction of oblique inguinal hernia. The sac (*c*) beyond the external ring (*b*) is empty, but the coil of gut remains outside the internal ring (*a*), and within the inguinal canal (Follin).

Omentum is very commonly met with, either alone (*epiplocele*), or with a coil of gut (*entero-epiplocele*), in which case it lies in front of the intestine, *i.e.* retains its normal position to it. In recent herniæ the omentum is unaltered in appearance, but when it has been down for some time the fat may become more or less absorbed, and the omentum reduced to a dense fibrous mass with dilated and engorged veins; sometimes, however, especially in fat people, large masses of fat accumulate in the omentum and render it, independently of adhesions, irreducible (p. 446).

Appendices epiploicæ may become detached, and lie loose in the sac as fibro-fatty foreign bodies.

In large umbilical and ventral herniæ any organ in the abdomen may be met with except the pancreas, which is firmly bound to the spinal column behind the peritoneum.

Cystocele or hernia of the bladder is rare, and, being devoid of a complete sac, the viscus may be irreducible owing to the contraction of adhesions; the hernia enlarges or diminishes in size according to the amount of urine contained in the bladder.

Adhesions.—In herniæ which have been irritated by an ill-fitting truss, or have inflamed, adhesions may form within the sac, which render the contents irreducible, and may be the cause of strangulation. The adhesions may be narrow and threadlike, form broad bands, or intimately unite opposed surfaces. They may pass (1) from one part of the wall of the sac to another without being attached to the contents, (2) from the wall to the contents, (3) may mat the contents together without being attached to the wall, (4) or may be met with in all these situations.

Fluid.—A small amount of clear serous fluid, secreted by the sac wall, is always present, and serves to lubricate the contents. If the hernia is inflamed or strangulated, the quantity of fluid is usually increased, and it may be turbid from the presence of lymph or blood, or may be purulent; in cases of strangulation the fluid is fœtid, contains the B. coli communis, and possesses septic properties.

In cases of ascites a hernial sac may be much distended by the effusion.

The term **hydrocele of a hernial sac** has been used to denote two separate conditions: (1) The fluid distension of an old hernial sac whose neck has been obliterated, so that it forms a definite cyst; this condition is very rare. (2) The lower part of the sac may be shut off from the upper part, and from the abdominal cavity by adherent omentum, and the part thus shut off becomes distended with the normal fluid secretion from the wall. To this condition the term hydrocele is more properly applied.

The coverings of a hernial sac are those structures which it pushes in front of it in its descent, and hence they vary according to the situation of the rupture. The coverings soon become stretched and thinned; they are adherent to one another and to the sac, so that, with few exceptions, the individual layers are unrecognisable as such during an operation, and the sac is rendered irreducible. In old cases, especially if the hernia has been inflamed or irritated by a badly-fitting truss, the coverings are considerably thickened by new fibrous tissue.

Etiology.—Hernia may be congenital or acquired.

A **congenital hernia** is so called, not because it is necessarily or even usually present at birth, but because the sac is due to the persistence of some structure (*e.g.* the processus ad testem), which normally becomes obliterated at or before birth (Fig. 144, p. 458). Doubtless in such cases there is also that abnormal condition of prolapse or elongation of the mesentery to be presently mentioned. Congenital umbilical and diaphragmatic herniæ are present at birth, and are therefore congenital in every sense, but the oblique inguinal variety, although usually met with in the young, may not descend until a much later period, although the sac is present from birth; nor does the existence of this congenital sac by any means necessarily entail the future descent of intestine or omentum. Femoral hernia is never congenital.

Acquired hernia.—It will be found, as has been demonstrated by C. B. Lockwood, that if the mesentery is of normal length, and is attached at its usual height to the spinal column (from the second to the fifth lumbar vertebra), it is impossible to drag any coil of it below the level of the pelvic brim, and hence it follows that in cases of femoral or inguinal ruptures at least, the mesentery must be either abnormally long, or being of normal length, must be attached lower down than usual (*prolapse of the mesentery*), or both conditions may be combined.

That the length of the mesentery is increased in hernial protrusions there is no doubt, but it must be remembered that when once a hernia has formed such elongation is almost inevitable, in view of the constant traction to which the mesentery is subjected, and consequently it by no means necessarily follows that the increased length was primary, or was in any way responsible for the abnormal position of the bowel. In the great majority of cases *prolapse* of the mesentery is the factor which allows the gut to protrude beyond the normal limits of the abdomen, and when once this has occurred, not only is the mesentery stretched and elongated, but the prolapse increases.

But even in cases in which these conditions of the mesentery are present, the bowel will not escape, provided the abdominal parietes are of sufficient strength to resist the intra-abdominal pressure, and therefore we must further look for some condition by which these are weakened. Congenital defects have already been referred to, and will be more particularly described under Special Herniæ. The abdominal wall may be weakened by the effects of injury or disease, and if coupled with this there is associated strain on the weakened wall, or increase in the intra-abdominal tension, the production of hernia is more likely to occur. Continuous strain or sudden exertion, especially in those with naturally lax abdominal walls, will often result in hernia, and hence the acquired form increases with advancing years, and diminution of the natural "tone" of the abdominal wall. A sudden loss of fat in the abdominal wall may, by weakening it, determine the development of hernia. Repeated pregnancies act similarly by diminishing the resisting power of the muscles, and by stretching the linea alba. Hernia is most usually met with in young children or after forty years of age; in the case of the former, the proclivity to the condition is dependent upon the frequency with which the congenital form occurs.

Men are much more liable to hernia than are women in the proportion of about 4 : 1, but this disproportion applies only to the total number of herniæ, and not to the relative frequency of any one special form; thus inguinal hernia, by far the commonest, is about seven times more frequent in men than women, whereas femoral hernia is rather more common in women, and the ventral and umbilical (except the congenital and infantile varieties) are almost confined to them.

THE GENERAL PATHOLOGY OF HERNIA

The contents of a hernial sac may be *reducible*, *irreducible*, or *strangulated*; the irreducible hernia may further be *inflamed* or *incarcerated*.

REDUCIBLE HERNIA

A reducible hernia is one in which the contents can be replaced within the abdomen. Some herniæ are only partially reducible—that is, only part of the contents can be reduced.

Nearly all herniæ are easily reducible at first and may always remain so.

Signs and symptoms.—When a hernia is quite small and has not escaped from the dense structures among which it first passes, it merely gives rise to a slight rounded or oval bulging of the abdominal wall, which is not usually noticeable when the patient lies down but becomes so on coughing, or by any act which increases the intra-abdominal tension. As soon as the hernia escapes from the dense structures into loose cellular tissue it enlarges and the signs characteristic of its nature become more evident. It is rounded or pyriform in shape, extends upwards into the abdominal cavity, and the patient may be aware that it gradually grew downwards and not from below upwards. The swelling is soft and elastic, and there is a distinct and characteristic impulse on coughing. Palpation may prove that the hernia contains gut which gives a peculiar gurgling feeling; when omentum is present there is a sense of resistance and irregularity.

Reduction by taxis is the crucial test of the nature of the case. For its successful employment without damage to the gut the anatomy of the parts and the direction taken by the hernia (which must be made to re-traverse the path by which it escaped) must be borne in mind. The necessary manipulation must be steadily and carefully conducted so that, if the rupture prove to be irreducible, no damage is inflicted on it.

Taxis is performed as follows:—The patient lying on his back in an easy unconstrained position so that the structures involved are relaxed to the utmost, the surgeon grasps the neck of the sac with the fingers of one hand and draws it gently but firmly downwards so that it may be straightened out and steadied. The hernia is taken in the other hand, and being gradually and firmly compressed, is gently pushed backwards towards the abdominal cavity, being made to enter it along the path of its escape, the direction depending upon the special position of the hernia. By this means the part of the hernia which came down last is reduced first. The reduction of bowel is easy of recognition as it suddenly slips back with a characteristic gurgle; omentum is not so easily reduced, and although it finally disappears suddenly there is no gurgling.

It may be found that only some portion of the hernia is reducible, usually the gut, while the omentum being adherent to the sac wall, or being very fat, cannot be returned. If after a fair trial reduction is found to be impossible, the attempt must be discontinued or considerable damage may be inflicted. When a hernia has been reduced, the opening through which it left the abdomen is easily demonstrable. Small reducible ruptures do not usually occasion much inconvenience, but if much gut is protruded, the patient may suffer a good deal of annoyance and even pain; dyspeptic symptoms and difficulty in obtaining proper action of the bowels add much to his discomfort.

Treatment of reducible hernia—The application of a truss.—In children a permanent cure may sometimes be effected by the pressure of a truss, provided the following conditions be fulfilled:—

(1) The truss must fit accurately and be of sufficient strength to keep up the hernia, but must not be so strong that its pressure induces irritation, or the child will certainly loosen it.

(2) It must be put on before the child assumes the erect posture in the morning and worn continuously during the day, but may be taken off when he is lying down at night. In some cases a lighter truss should be worn at night, especially if the child is very restless.

(3) The truss must be continuously worn for a year after the last appearance of the hernia.

(4) No attempt should be made to induce the child to bring down the hernia, for if it once comes down the treatment has to be begun again.

(5) For bathing purposes a vulcanite or india-rubber truss should be worn.

In private practice the treatment by truss is often successful, for the parents and attendants are usually intelligent enough to understand the nature of the treatment, and may be trusted to carry it out so that this method may be given a fair trial before any operation is determined on. In hospital practice success is rare. Any cause which induces straining on the abdominal wall, such as chronic constipation, or a tight prepuce must be removed.

In adults a truss never produces cure—the most it can do is to keep the hernia up.

The following directions should be given the patient:—

(1) The truss must always be worn during the day, and in very large herniæ which are troublesome to keep up, it should also be worn at night; the tendency of the hernia to come down will usually be materially diminished in a short time.

(2) It must be put on after the hernia is reduced.

(3) If the rupture slips down under the pad the truss must be removed and re-applied after reduction has been effected.

(4) If at any time the patient cannot reduce his hernia, he should at once apply to his medical attendant.

A well-fitting truss should not gall the patient, and should have a pad broad enough to cover the entire weak area and not merely press upon the aperture of escape. Its strength must be adapted to the age of the patient and the necessity for special support which his occupation may demand.

Radical cure by operation.—The radical cure of hernia by operation may be undertaken at almost any age without danger. In little children fair trial should usually first be made to effect cure by a truss unless the hernia be very large or the patient's friends are not likely to carry out the treatment with any prospect of success. The operation is especially to be advised in young adults, for irreducible hernia, after an operation for strangulation, and is compulsory on those seeking admission to the public services. In the old, and in the case of a very large irreducible hernia the operation is not advisable, indeed, in the latter case it is impossible, as the hernia cannot be reduced (see p. 447).

The operation itself, if conducted with care and under proper antiseptic precautions, is almost devoid of risk, but it by no means ensures a radical cure, for in a considerable proportion of cases (about 15-20 per cent) recurrence takes place, although it may not do so for some years. The radical cure of femoral hernia is rarely followed by recurrence. The operations will be considered under each form of hernia, it sufficing here to mention that the general aim is ligature of the neck of the sac, removal of its body and fundus, and suturing of the aperture of exit with kangaroo tendon. As a rule there is no necessity for the patient to wear a truss after the operation, although some surgeons recommend it; if there is any bulging on forced expiration, a light truss may be worn for the first few months with advantage.

IRREDUCIBLE HERNIA

Causes.—The contents of a hernia may be wholly or partly irreducible, and when once it is so the rupture gradually increases in size and may become incarcerated or inflamed.

Irreducibility is most usually met with in omental hernia, especially the femoral or umbilical variety. Irreducibility may be due to one of the following conditions:—(1) Gradual narrowing of the neck of the sac by fibroid overgrowth; (2) adhesions between the sac and its contents, or matting the contents together; (3)

the accumulation of fat in omentum which has entered the sac and been allowed to remain there without reduction; (4) certain anatomical conditions in which there is no sac or only a partial peritoneal covering, *e.g.* hernia of the bladder; (5) mere size in very fat people, there being no room in the abdominal cavity for the hernial contents.

Signs and symptoms.—The history is usually conclusive; the patient states that the hernia was at one time easily or spontaneously reducible, but that the difficulty attending reduction gradually increased until taxis has been finally abandoned as useless.

Physically the tumour presents the same characters as are met with in reducible herniæ, with the exception that it cannot be returned, although portions of the contents may slip back.

There is usually some trouble with the bowels and dyspeptic symptoms, especially if the hernia be large and contains colon; the patient complains of a sense of local discomfort, of weight and dragging, with colicky pains in the abdomen. There is often constipation, nausea, occasional tympanites especially after food, and perhaps depression of spirits and irritability of temper. In some cases the patient suffers little or no inconvenience.

Treatment.—It sometimes happens that an irreducible hernia may be made reducible by putting the patient on a limited diet (especially if he be fat, and it is probable that fatty accumulation has occurred in protruded omentum) combined with complete rest in bed, small doses of blue pill, and daily taxis for from ten to twenty minutes, with continuous weight pressure. As such treatment must be carried out for weeks, and has the further disadvantage of being more often a failure than a success, few patients will submit to it.

If it is decided to treat the case by a truss, a cast of the hernia should be taken and an accurately moulded concave pad made to fit it. The spring should have considerable strength, so that the pad may exercise continuous pressure and prevent further enlargement of the rupture. By constantly wearing such an apparatus the hernia is sometimes rendered reducible. If palliative treatment is alone adopted, the patient must be warned of the risks of incarceration and strangulation; the diet must be carefully regulated, heavy meals interdicted, and the daily action of the bowels ensured.

Radical cure.—In the young, and in the case of herniæ of no great size, a radical cure is usually to be recommended. The operation must be very carefully conducted so that adherent bowel be not damaged when the sac is opened or while adhesions are being separated. If the sac is broadly adherent at any part to a coil of gut, this portion may be cut away and reduced with the coil. Omentum may in all cases be removed with advantage, and must be so when large masses of fat accumulated in it are the cause of the irreducibility. In very large herniæ in fat patients no attempt should be made to effect radical cure, for this will be found impossible, inasmuch as the abdominal cavity is occupied by fat, and there is no room to accommodate the protruded bowel and omentum.

INCARCERATED IRREDUCIBLE HERNIA

When the lumen of the bowel in an irreducible hernia becomes obstructed by fæcal matter or undigested food it is said to be incarcerated. Incarceration is most commonly met with in the large umbilical herniæ of fat, elderly women, who indulge too freely at the table and neglect their bowels; it may also occur in large inguinal herniæ. An incarcerated hernia will nearly always be found to contain colon, since the fluid contents of the small gut are not at all likely to lead to impaction.

Signs.—There is usually a history of long-continued and gradually increasing constipation which, perhaps, alternates with spurious diarrhœa. The patient has complained for some time of tympanites, distension after food, and dyspeptic symptoms, and the last straw has probably been an injudicious and copious meal of a highly indigestible nature. There is colic which may be severe and cause much suffering; nausea and retching are present, but the vomiting is never severe or fæcal.

The hernia is tense and hard, but not so tender and tense as when strangulated; it is usually doughy to the feel and dull on percussion, but may be tympanitic if there is much gas in the bowel; with the onset of the symptoms the hernia usually increases in size. The natural impulse is much diminished in intensity though still present. The passage of flatus and liquid motion is common and is an important diagnostic feature from strangulation. The patient is often somewhat prostrated by the colicky pain, but there is not the marked collapse of strangulation.

Treatment.—The prevention of incarceration is aimed at by careful dieting and attention to the bowels in all cases of irreducible hernia. Incarceration must be treated by rest in the dorsal position combined with the employment of large purgative enemata, and gentle taxis to the hernia; a purge by the stomach may be given if there is not very great pain. Opium should be avoided, as it tends to allay peristaltic action; severe pain may be diminished by the use of the icebag. Under treatment the incarceration usually yields in a day or so and may do so at once if part of the hernia can be reduced.

When the patient has quite recovered from the effects of the incarceration the advisability of radical cure must be determined on the circumstances of the case; if the size of the hernia and the age of the patient negative operation, it only remains to provide a suitable truss and give stringent directions as regards diet and constant attention to the bowels.

INFLAMED IRREDUCIBLE HERNIA

Local peritonitis may occur in a hernial sac, but is rare; it causes symptoms somewhat similar to those met with in cases of strangulation. As a result of the inflammation adhesions are formed within the sac which still further increase the difficulties of reduction. Suppuration is very rare. The inflammation may be excited by injudicious and prolonged attempts at taxis or other form of injury; it may also follow severe purging.

Symptoms.—The patient complains of considerable pain in the rupture which is tender, enlarged, and rather tense, but retains its impulse on coughing. The pain is superficial and is accompanied by colic and radiating abdominal pain. The patient may be slightly febrile and complain of malaise, but the general disturbance is usually trivial and unaccompanied by the marked prostration of strangulation. Nausea and vomiting are present, but the vomited matter is never stercoraceous. Constipation is not complete, and flatus passes readily.

The symptoms usually quickly subside under treatment and the patient is convalescent in three or four days; very rarely the inflammation spreads to the general peritoneal cavity with serious results.

Treatment is conducted on the same lines as that of general peritonitis.

The bowels should be opened by enema at the onset of the symptoms, or a mild saline purge may be given. Pain may be relieved by opium internally and the ice-bag to the tumour. When all symptoms have subsided the propriety of undertaking a radical cure by operation must be considered (see p. 447).

STRANGULATED HERNIA

A hernia may be so tightly nipped that the circulation through it is arrested; it is then said to be strangulated. This is the most common cause of acute intestinal obstruction.

Causes.—Sometimes a hernia, especially if of congenital origin, is strangulated at its first appearance; in such cases the strangulation is usually tight and severe and, unless speedily relieved, gangrene will ensue. More usually the hernia has been in existence for some time, but owing to a sudden increase in the intra-abdominal tension—such as may be induced by a violent strain or fit of coughing—an additional piece of gut or omentum is forced down through the ring which cannot yield correspondingly, and thus strangulation is brought about.

Morbid anatomy.—The method by which strangulation is produced does not differ in any respect from that which may occur in any part of the body which has been unduly constricted by a tight ligature—such a state of things is sometimes seen in the finger when a too tight ring has been pushed on and cannot be withdrawn. The resistance offered by the constricting ring through which the hernia passes is partly compensated for by closure of its lumen if the protruded portion be bowel, but as its collapse is not sufficient the thin-walled veins are pressed upon, the venous circulation is impeded, and congestion and œdema of the protruded portion ensues. The swelling of the bowel increases the pressure until the more resistant arterial coats are compressed, and all circulation through the gut is abolished. It has already been stated (p. 399) that interference with the circulation is the principal factor in inducing distension of the bowel with gas, and hence the protruded gut becomes considerably inflated. If the stricture be left unrelieved the gut rapidly becomes gangrenous, and the death of the patient may result from exhaustion or septic peritonitis, or the gangrenous process may extend to the inflamed coverings, and

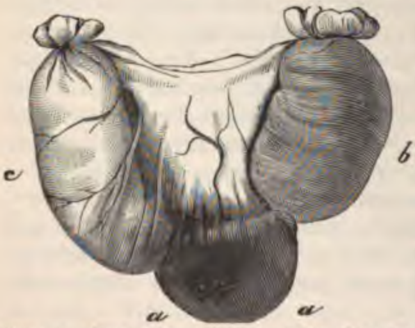

FIG. 142.—Strangulation of the small intestine. *aa*, strangulated portion; *b*, upper and *c* lower, portion of the bowel (Follin).

spontaneous relief be afforded by the establishment of an artificial anus.

The constricting band is usually a thickening of the neck of the sac itself, but may be some tendinous structure (*e.g.* Gimbernat's ligament) external to it, or a band of adhesion or adherent omentum within the sac under which the bowel passes. As regards the gut itself, its appearance varies with the tightness and duration of the stricture. If it is simply congested, the wall is swollen and œdematous, and may be coated with a few flakes of inflammatory lymph; it is of a deep purple colour and often flecked with minute extravasations; the fluid in the sac is slightly turbid and increased in quantity; the sac itself and the coverings are unaffected. If the bowel be drawn down the seat of the constriction is indicated by a deep ring (Fig. 142).

When gangrene has occurred it may be quite local, and only affect the part compressed by the stricture, or the whole protruded loop may be gangrenous. The gut is ashy-gray, dark-green, or black in colour; the fluid in the sac is blood-stained, dark and offensive, and the parts are emphysematous; the sac-wall and coverings are inflamed and may be sloughy.

Sometimes in strangulated femoral hernia only a portion of the circumference of the bowel is protruded (*Richter's hernia*), and although the signs are not quite so severe the danger is great owing to the tightness of the stricture.

Signs and symptoms.—The symptoms of strangulation are those detailed at p. 398, as being common to all forms of acute intestinal obstruction. The sudden onset, marked prostration, severe pain in the abdomen, especially round the umbilicus; constipation, nausea, and persistent vomiting which becomes stercoraceous being characteristic, and whenever these symptoms are present, hernia should always be sought for. On examination, the hernia will be found very tender, tense, and perhaps tympanitic, and the patient may notice that it is rather larger than usual. It is irreducible, and even gentle taxis causes considerable pain; there is no impulse on coughing and the tumour is usually dull on percussion. Sometimes the rupture is so small that it merely conveys a sense of resistance to the touch, which, coupled with the local pain and general signs of obstruction, alone indicate the nature of the case. Such a condition of things may be met with in the femoral herniæ of fat women, especially if Richter's variety is present.

If the sac of a hernia only contains omentum, the local pain, tenderness, and tension may be very slight, and the vomiting is by no means constant and does not become stercoraceous.

When the gut becomes gangrenous and gives way the patient complains much less of pain, which may indeed quite subside, so that he is hopeful of speedy convalescence; but he quickly becomes markedly collapsed, the face is drawn and anxious, the pulse small, intermittent, or irregular, the extremities cold, and hiccough with slight delirium usher in death.

If gangrene terminates in affording spontaneous relief by the formation of an artificial anus the integument shows signs of inflammation, becomes œdematous, dusky, and emphysematous, and finally sloughs.

Diagnosis.—The diagnosis of strangulated hernia does not usually present any difficulty. The undoubted intestinal obstruction (of which continued vomiting, culminating in stercoraceous vomit, is the most important sign), the sudden onset and collapse, with the presence of a tense, tender tumour at a seat where hernia may occur, being the characteristic features.

In the case of a very small hernia there may be some difficulty in detecting its presence, which may only be indicated by some slight bulging or increased resistance with pain.

From **incarcerated hernia** strangulation may be diagnosed by the more sudden onset of the symptoms, the greater collapse and pain, the absolute loss of impulse on coughing, and the constant vomiting which becomes stercoraceous.

In **inflamed hernia**, although there is pain, nausea, and vomiting, the vomit is never stercoraceous and not usually persistent; moreover, flatus and even solid fæces may pass in considerable quantity.

If **double hernia** is present, it is usually quite easy to determine which one is strangulated, but should this be doubtful, the more likely sac should be cut down upon, and if strangulation is found to exist the second hernia need not be operated on, but if no strangulation is present this must also be explored.

It sometimes happens that a hernia, especially if small or omental, or of the kind known as Richter's, may not be either very tense or painful, and the surgeon may be led to suspect that the obvious signs of obstruction are due to some intra-abdominal cause and not to the hernia; but in such cases, all doubt should be cleared up by cutting down on the sac before resorting to laparotomy.

Acute bubo can hardly be mistaken for femoral hernia; the symptoms of obstruction are absent, although there may be nausea and vomiting. The temperature is raised and the local signs of acute inflammation, with perhaps the discovery of some sore on the penis or elsewhere, being sufficient to clear up the diagnosis. It must, however, be remembered that strangulated hernia may co-exist with lymph-adenitis.

An **inflamed retained testis** may produce symptoms very similar to those of strangulated hernia but the vomit is never stercoraceous; the temperature is raised and the testicle is absent from the scrotum—the last is not to be relied on too much, since a hernia may complicate non-descent of the testis and, in doubtful cases, the safest course is to cut down on the tumour and explore.

Treatment.[1]—The strangulation must be immediately relieved. Some surgeons still employ taxis in the hope of effecting reduction, but I feel strongly that the proper treatment is immediate operation. The operation itself, if properly performed, is devoid of danger and a radical cure may be at the same time effected. Taxis more frequently fails than succeeds, and in such cases the manipulation of the parts can only have inflicted additional harm; moreover, it is possible that by taxis, a still strangulated hernia may be reduced into the abdomen, or the sac and its contents may be pushed into the cellular tissue beneath the transversalis fascia (reduction *en masse*), and should either of these accidents happen the symptoms continue and an operation must be finally undertaken when the patient's powers have been still further exhausted.

Lastly, it is impossible in many cases to predict what is the actual condition of the gut, and taxis may reduce within the abdomen a coil of gut so damaged that gangrene must ensue, or the manipulation may itself cause rupture of the weakened and œdematous tunics.

If it is determined to resort to taxis (consent to operation in the event of failure having been obtained), the patient should be fully anæsthetised and careful taxis attempted (p. 444); it must not be persisted in for more than ten minutes, and no force must be employed. If chloroform is not within reach, the patient may be placed in a hot bath until he feels faint and taxis be then employed.

The application of ice, which is so often advocated, is not only useless but harmful, and valuable time is being lost—for every hour which passes adds to the patient's danger; it is difficult to see on what grounds the application of ice can be recommended.

Herniotomy.—The neck of the sac must be exposed by a sufficiently free incision to afford ample room for manipulation. When the sac is exposed it must be gently picked up and opened some little distance from the neck; the escape of fluid will denote that this has been done. The fluid must be washed away by free irrigation before any further steps are taken, for it contains the B. coli communis and is septic. If the gut is not gangrenous, the finger is introduced and the constricting band (usually at the neck) is sought for and divided with a blunt, probe-pointed bistoury or hernia-knife, the contents of the hernia being protected against injury by the finger which guides the knife. When the stricture is sufficiently divided the coil of gut must be further pulled downwards from the abdomen, so that its condition at the point of compression by the strangulating band may be examined. When the stricture is cut and while the subsequent examination is taking place, the gut, which was at first deeply congested, may become paler in colour, indicating that circulation is being re-established and arguing speedy convalescence. Gangrenous gut is recognised by its green or greenish-black colour, by loss of peritoneal lustre, and by emphysema of the coats, and the fluid in the sac is often fœtid; it is never to be reduced (see below).

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[1] For the general treatment applicable to cases of intestinal obstruction see p. 403.

The gut having been reduced, the sac is dissected up and tied at the neck with silk, and the radical cure completed by suturing the ring.

Treatment of strangulation by adhesions.—If it be found that the strangulation is due to a band of adhesion involving the bowel, or that the latter has passed beneath a piece of adherent omentum, the case is practically one of strangulation by a band, which must be removed.

Treatment of omentum.—If omentum is present in the sac it will be seen immediately this is opened, and if it be lifted up a coil of gut may be found behind it. The omentum should be further pulled down and removed beyond the point of constriction, or may, unless much damaged, be returned; removal is perhaps the wisest course in all cases.

Treatment of gangrene of the gut.—The ideal treatment of this condition would be immediate resection of the bowel, and this has indeed been strongly advocated by some surgeons. The treatment is however rarely to be recommended, for even under the most favourable conditions it prolongs the operation, deepens the shock, and much increases the danger of the patient who is, in such cases, already in a desperate condition. If the gangrene is quite limited it has been suggested to cut out the affected portion, and unite the edges of the wound with Lembert's sutures, but the same objections apply to this as to complete resection.

The method to be adopted should be as follows:—First freely irrigate the sac to wash away all the septic fluid contents, then freely lay open the gut and again employ irrigation. The neck of the sac should not be divided, as this will open up the general peritoneal cavity and court the occurrence of diffuse septic peritonitis. The lumen of the bowel may be gently dilated by introducing a well-padded pair of dressing forceps and subsequently the finger. If the patient survives the operation, the resulting artificial anus should be subsequently closed when his general condition has materially improved (see p. 437).

Treatment of strangulated irreducible hernia.—In ordinary cases when the strangulation has been relieved the adhesions can be carefully dissected off and the hernia reduced into the abdomen. If the hernia is irreducible by reason of there being no sac, so that the viscus is itself adherent to the coverings, division of the constricting band is all that can be done, and this must be sufficiently free to ensure the safety of the gut when healing, and subsequent contraction occurs. In very large irreducible hernia the same course must be adopted, since such can but rarely be reduced into the abdomen which is occupied by much fat.

After-treatment of herniotomy.—When the gut has been reduced and the operation completed by a radical cure, the wound should be closed and a dry antiseptic dressing applied, which should remain untouched for a week, provided there are no symptoms indicating the necessity for its removal. A hypodermic of morphia should be given and the patient placed on his back with the thighs raised on a pillow. The bowels will usually act normally in two or three days, but should they not do so, a purge should not be given, but at the end of a week a glycerine or hot soap-and-water enema must be administered.

During the first twenty-four hours the patient rarely requires food, but thirst is often distressing, and may be quenched by a little hot water by the mouth, or a larger quantity by the rectum; subsequently the food must consist of beef-tea, milk, meat-jelly, and similar nourishment until the bowels have acted, when a more liberal diet may be safely allowed.

After-dangers and persistence of symptoms—Shock.—If the strangulation has not been detected for some days, and especially if it be tight, or the patient old, death may result from shock. If a hernia is operated on within twenty-four hours of the occurrence of strangulation the case nearly always does well, but delay beyond this time adds much to the danger.

Peritonitis may spread to the abdominal cavity from the sac, especially if this was not well flushed before the neck was divided, for in such a case the septic fluid readily excites inflammation. Peritonitis may also be due to subsequent gangrene of the bowel at the point which was constricted.

Gangrene of the gut may occur, subsequent to its reduction, if the bowel was very tightly strangled, or the condition had been present for some time before relief was afforded. Should this accident happen the patient may die of acute perforative peritonitis, but in more favourable cases adhesions take place between the gut and the abdominal wall, and a fæcal fistula or artificial anus results.

Acute inflammation of the strangulated loop sometimes supervenes, especially in those cases in which, owing to faulty diagnosis, strong purgatives have been administered with the view of opening the bowels. The condition is marked by pain, collapse, and probably bloody mucous diarrhœa. Under these circumstances chief reliance must be placed on opium, bismuth, and free stimulation.

The persistence of symptoms of obstruction after herniotomy may be due (1) to paralysis of the bowel from injury; (2) to the existence of some other cause of intestinal obstruction. If the symptoms persist laparotomy should be performed, and if the gut be found paralysed the loop should be drawn up and emptied by aspiration, or an artificial anus must be formed.

Persistence of symptoms of obstruction after reduction by taxis may be due (in addition to the causes already given as being operative after herniotomy) to the reduction within the abdomen of a still strangulated hernia, or to reduction *en masse*, *i.e.* the sac and its contents are forced up beneath the fascia transversalis, and the stricture has therefore not been relieved; this accident only occurs in inguinal hernia. In the former case laparotomy must be performed; in the latter, which may be recognised by a fulness in the canal accompanied by tenderness, and may be suspected if the hernia "went back" with much difficulty, and a doubt was left in the mind as to its complete reduction, the canal (which will be found to be more than usually patent) should be laid open, the misplaced hernia drawn down, and the operation of herniotomy performed. It should be noted that reduction *en masse* is often due to violent attempts at reduction by the patient himself who has been accustomed to replace his hernia.

SPECIAL HERNIÆ

INGUINAL HERNIA

Anatomy of the inguinal canal.—The inguinal canal is the passage between the muscles of the abdomen which transmits the cord or round ligament. It is about one and a half inch long, and extends obliquely upwards and outwards from the spine of the pubes above Poupart's ligament. It is bounded by the internal and external abdominal rings. The anterior wall is formed by the skin and external oblique tendon, and at the outer third by the fleshy fibres of the internal oblique which arise from Poupart's ligament; the posterior wall is formed by peritoneum and fascia transversalis, and for the inner two-thirds by the conjoined tendon. The floor corresponds to the meeting-place of Poupart's ligament and the fascia transversalis, and the roof is formed by the arched lower borders of the internal oblique and transversalis muscles. The internal ring is half an inch above Poupart's ligament in the line of the external iliac artery; it corresponds to that part of the fascia transversalis which is prolonged over the cord as the infundibuliform process; to its inner side the epigastric artery courses upwards towards the umbilicus. The external ring is an opening in the external oblique; prolonged from its pillars is the intercolumnar fascia which forms a covering for the cord.

Inguinal hernia is by far the commonest variety, and may occur in either sex, although it is much more frequent in the male. It is not uncommonly bilateral, and is sometimes associated with varicocele or hydrocele (Fig. 181, p. 625).

When the rupture lies within the canal it is spoken of as a *bubonocele*, but after passing the external ring the term *scrotal* is applied to it. An inguinal hernia may be congenital or acquired, and the latter may traverse the whole length of the canal (*oblique inguinal hernia*, Fig. 147, p. 459), or may pass only through the external ring (*direct hernia*, Fig. 148, p. 460). The direct hernia is also said to be *internal* and the oblique *external* from the relation of the neck of the sac to the deep epigastric artery. Congenital herniæ are always oblique or external.

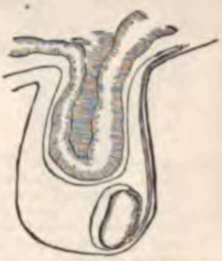

FIG. 143.—Inguinal hernia. The condition depicted is that usually present; the testicle and tunica vaginalis are seen below.

Oblique or external inguinal hernia—**Anatomy.**—The hernia passes through the internal ring, traverses the inguinal canal, and escapes into the scrotum through the external ring. The coverings as they would be met with in an operation are: skin, superficial fascia, intercolumnar fascia, cremasteric fascia, infundibuliform process of the fascia transversalis, subperitoneal fat, and the peritoneum forming the sac. The cremasteric fascia, containing bundles of muscular tissue, can always be identified. The epigastric artery lies internal to the neck of the sac running upwards and inwards towards the middle line. The vas deferens and cord lie behind, except in the infantile form to be presently mentioned.

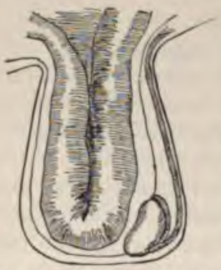

FIG. 144.—Congenital hernia. The bowel has entered the unobliterated processus and lies in contact with the testicle.

Congenital inguinal hernia may occur in either sex, but is specially common in male children, and is often bilateral. The hernia is not itself necessarily congenital, and may occur at any period of life, but it is so called because it is dependent upon a congenitally persistent fœtal structure.

In the male the defect consists in complete or partial patency of the processus ad testem. If the processus is entirely patent the hernia descends along it into the tunica vaginalis, and lies in direct contact with, and in front of the testis (Fig. 144); but if the tunica vaginalis has been shut off by obliteration of the processus below, the hernia, entering the upper unobliterated portion, does not actually touch the testicle but lies above, or in front of it if it has descended low enough (hernia into the funicular process). In other cases the processus may be only obliterated above, so that it is shut off from the abdominal cavity, and should a hernia then form the sac descends behind the processus (Fig. 145), and the testis will lie

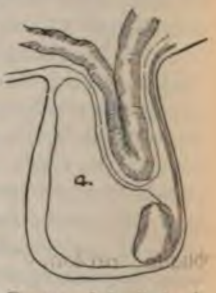

FIG. 145.—Infantile hernia. The processus and tunica vaginalis (*a*) are represented as being distended; behind this the hernia and its sac are situated.

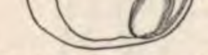

FIG. 146.—Encysted infantile hernia. The processus is only obliterated at the abdominal end, where it has become doubled on itself by the descent of a portion of bowel. The processus and tunica vaginalis (*a*) are represented as being distended.

either directly below, or below and in front of the hernia which is said to be *infantile*. Sometimes the hernial sac is formed by the invaginated processus (*encysted infantile hernia*, Fig. 146). An infantile hernia may be, but is not necessarily congenital, and when it is so, Lockwood considers that the congenital sac is due to the fact that the gubernaculum testis drew down two peritoneal pouches, *i.e.* the processus and the hernial sac. In operating on infantile hernia three layers of peritoneum will be encountered before the contents are exposed, viz. the anterior and posterior walls of the processus and the anterior wall of the sac, but this will not be the case in the encysted variety (Fig. 146).

In females a congenital hernia descends along the patent canal of Nuck, and if it escapes beyond the external ring enters the labium; such a hernia sometimes contains the uterine appendages of the side on which it occurs.

From unexplained reasons a pouch or diverticulum may form from the unobliterated processus ad testem or canal of Nuck, and may pass up between the oblique muscles and contain bowel (*interstitial hernia*, Fig. 140, p. 440).

Direct or internal inguinal hernia.—This form of hernia is comparatively rare, and is never congenital. The hernia leaves the abdomen through Hesselbach's triangle, pushing in front of it the conjoined tendon, and escaping through the external ring. The coverings are the same as in the oblique form, with the exceptions that the cremasteric fascia is replaced by conjoined tendon or internal oblique, and the infundibuliform process of the fascia transversalis is replaced by that portion of the fascia lying behind the conjoined tendon. The epigastric artery lies to the outer side of the neck of the sac, and the vas deferens and cord external to and behind it.

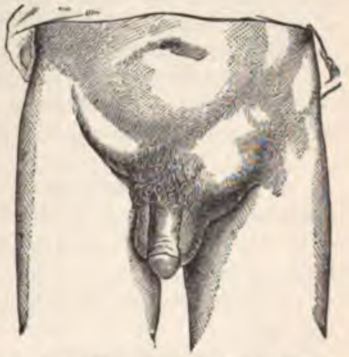

FIG. 147.—Oblique inguinal hernia (Bryant). Bubonocele on the right side; on the left the hernia has passed through the external ring.

Diagnosis of inguinal hernia.—When lying within the canal (*bubonocele*), the hernia forms a mere bulging, which is evident when the patient is in the erect position, and is accentuated by any forced expiatory effort. It usually disappears when he lies down

As soon as the hernia becomes scrotal, it assumes a pyriform shape, with the base downwards, and the neck extends up to and through the external abdominal ring. The testicle is placed below and behind, except in the infantile form, in which it lies below, or below and in front. The tumour presents the characters already given at p. 444; and when it has been reduced, the external ring will be found to be abnormally patent. The diagnosis presents but little difficulty.

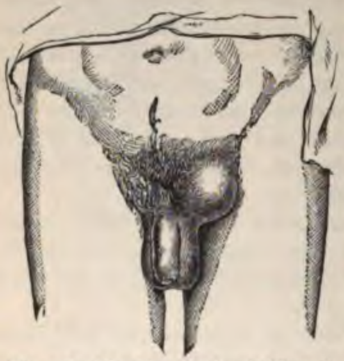
FIG. 148.—Direct inguinal hernia (Bryant).

From a **femoral hernia** (Fig. 150, p. 464) the inguinal form is diagnosed by its position above Poupart's ligament, internal to the spine of the pubes, and if it has escaped from the canal it lies within the scrotum or labium, according to sex. In fat women there may be some difficulty in making out the two first points, otherwise the diagnosis is easy.

From **tumours of the testicle** the detection of the healthy testicle distinct from the swelling, the impulse on coughing, and reducibility of the hernia are sufficient to prevent error. In large congenital herniæ the testis is not always easily discernible.

Hydrocele of the tunica vaginalis can be distinguished by its translucency, its obvious connection with the testicle, and the freedom of the external ring, except in those cases in which the processus remains patent below and the hydrocele extends to the canal (*infantile hydrocele*).

A bubonocele may be distinguished from **hydrocele, or fatty tumour of the cord**, by the fact that, although these appear to be reducible, they do not really go back, and that even this apparent reducibility is abolished if the testicle be held so that the cord (to which these tumours are attached) cannot be pushed upwards into the canal.

From **retained testicle**, with which hernia is sometimes associated, the diagnosis is not always easy; the absence of the testis from the scrotum, the solid feel of the tumour, and its incomplete reducibility being the main points of distinction.

Treatment of inguinal hernia.—If it is decided to employ a truss, either with the view of attempting cure in a child, or of keeping the hernia up in an adult, it is always advisable to use a double rather than a single truss, the pads of which must fit over the entire length of the canals, and not only over the rings. The only measurement usually asked for by instrument makers is the circumference of the pelvis, midway between the iliac crest and the top of the great trochanter; but it is better also to measure the distance between the symphysis pubis and the anterior superior iliac spine. The precise make of truss must depend upon the age and occupation of the patient, and upon the size of the hernia and the ease with which it can be kept in place. In young children it is necessary, with the view of effecting a radical cure, to keep a truss constantly applied; for this purpose a light one should be made for night wear, and an india-rubber or vulcanite truss for bathing purposes. For infants, vulcanite is the best material, since it does not become spoilt by urine. Adults should be advised to keep a spare truss in case of accident. As a rule, the most serviceable kind is made with a broad pad, which should be so adjusted as to bring the walls of the canal into apposition. The pad should be well stuffed, and covered with chamois leather; but if this causes irritation, an air-pad may be substituted. In cases in which there is difficulty in retaining the hernia, the rat-tailed truss will often succeed when other forms fail. When the patient does not require a heavy truss, Salmon and Ody's is a useful make. A truss should be made with under-straps, to pass from front to back round the inner side of the thighs, and a strap should also pass between the two pads.

Radical cure by operation may be performed as follows:—An incision of sufficient length to fully expose the external ring and greater bulk of the sac is made in the middle line of the long axis of the hernia. The pillars of the ring are carefully defined, and the sac exposed by division of its coverings as far up as the internal ring, which may necessitate some splitting of the external oblique. The coverings are then peeled off with the fingers. The vas deferens and cord should be sought for, isolated, and protected from injury. When the sac is freed, it should be opened, and the hernia reduced. The sac is now separated from the canal for some distance by the finger, and having been pulled well down, the neck is ligatured with stout silk, care being taken that the vas deferens is not included. The sac is removed and the stump allowed to slip back. If the hernia is into a patent processus, the sac is divided after ligature of the neck, and the middle portion being cut away, the lower is closed by a few points of chromic catgut, so that the tunica vaginalis is shut off. The sutures for closing the canal should be of kangaroo tendon, or, failing this, of silk, and must unite the conjoined tendon to

Poupart's ligament as well as the pillars of the external ring. They are introduced by means of a handled needle, guided by the finger placed in the canal, which also protects the cord. In men, the rings must be left open below for a sufficient extent to allow of the free passage of the cord. The wound is closed with horsehair sutures. Drainage is only necessary if the sac is very large, and may then be obtained by a few strands of silk drawn out of the lower end of the wound.

The dressing may remain untouched for ten days, when the wound will be found to be soundly healed.

Several modifications of the operation have been devised and are practised; thus invagination of the sac into the canal, fixation of the stump in the canal by sutures passing through the abdominal wall, torsion of the sac before its ligature and removal, and various other methods are in vogue, but need not be described here.

Bassini's operation is applicable to bad cases, in which suturing the rings seems inadequate, or when recurrence after operation has occurred; shortly described, it consists in laying open the inguinal canal, isolating the cord, and then suturing the lower border of the internal oblique and conjoined tendon to Poupart's ligament, the union being effected behind the cord. The external ring is closed after the divided external oblique has been sutured.

Strangulated inguinal hernia.—The seat of the constriction is usually at the neck of the sac, opposite the pillars of the external ring. The incision must always be made in a direction upwards, so that the danger of wounding the epigastric artery may be avoided, since in many cases it cannot be definitely ascertained whether the hernia is oblique or direct, and hence whether the vessel is lying internal or external to its neck.

If any doubt exists as to the diagnosis between strangulated bubonocele and inflamed retained testicle, the swelling should be cut down upon and examined; if it be found that the testicle is at fault, it may be at once removed.

FEMORAL HERNIA

Femoral hernia is never congenital, and is more common in women than men.

Anatomy.—The hernia passes along the crural canal forwards through the saphenous opening, and then upwards towards Poupart's ligament, and if very large, may lie above this structure. A knowledge of this change of direction in its course is of importance in the employment of taxis. The crural ring is bounded internally by Gimbernat's ligament and the spine of the pubes, externally, by the femoral vein; behind, by the pubic bone and pectineus muscle with its fascia; and in front by Poupart's ligament and the deep crural arch; above is the cord or round ligament. Crossing obliquely above is the epigastric artery; and if the obturator artery arises from this, or from the external iliac, it may pass downwards external to, and behind, the neck of the sac, or cross in front of it and to the inner side. In the latter case the artery is immediately behind Gimbernat's ligament, and is in danger of being wounded when this structure is divided in cases of strangulation.

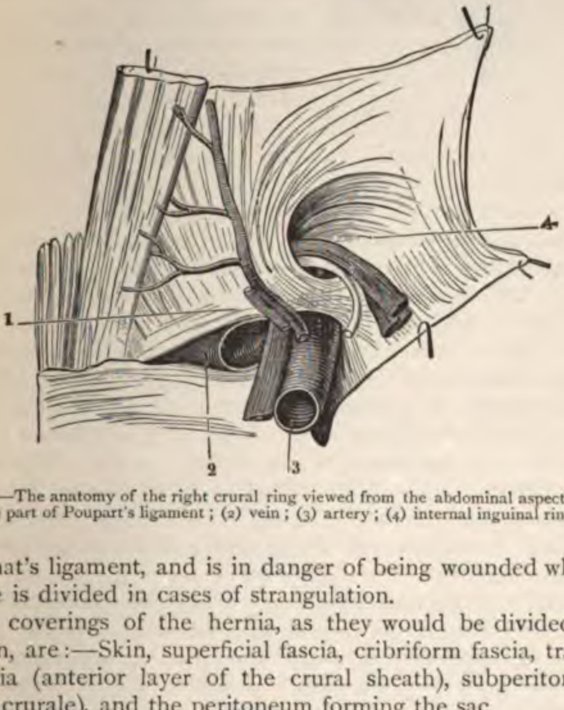

FIG. 149.—The anatomy of the right crural ring viewed from the abdominal aspect (Follin). (1) part of Poupart's ligament; (2) vein; (3) artery; (4) internal inguinal ring.

The coverings of the hernia, as they would be divided in an operation, are:—Skin, superficial fascia, cribriform fascia, transversalis fascia (anterior layer of the crural sheath), subperitoneal fat (septum crurale), and the peritoneum forming the sac.

Femoral hernia is often irreducible, and usually consists of ileum, but omentum may be present. The uterine appendages are occasionally found, and I have once met with Meckel's diverticulum. It is in the femoral region that Richter's hernia is met with (see p. 440).

Diagnosis of femoral hernia.—A femoral hernia may be so small, and, in fat women, so deeply situated, that its presence is undetected until symptoms of strangulation lead to a careful examination. These herniæ are rarely large, but may even extend upwards on to the abdominal wall. The diagnosis from the inguinal variety has been referred to at p. 460.

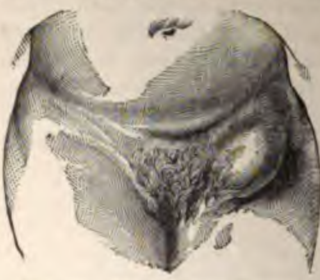
FIG. 150.—Femoral hernia (Bryant).

Very small herniæ give rise to some slight bulging or fulness between the femoral vessels and pubic spine, coupled with pain, especially on manipulation. Such local signs, with evidence of intestinal obstruction, should always lead to an exploratory operation.

Enlarged glands and simple tumours may occasionally resemble hernia, especially if it is irreducible.

Psoas abscess passes into the thigh external to the femoral vessels, and is easily diagnosed by careful examination.

Treatment.—The following measurements should be taken for a femoral truss:—(1) The circumference of the pelvis midway between the crest of the ilium and the great trochanter; (2) the distance of the saphenous opening from the anterior superior iliac spine, and from the symphysis pubis; and (3) that from the pubes to the iliac spine. It is important that the truss should fit accurately, and that the pad should not be too large, or it may cause considerable pain from compression of the femoral vessels. This form of hernia is not well adapted to treatment by truss, and unless there are reasons to the contrary, an operation should be performed. If the hernia is irreducible, and an operation is not to be performed, it should be protected by a hollow pad truss.

Radical cure by operation is more successful as regards permanency of cure than in the case of other herniæ. For the past ten years I have successfully employed the following operation, which I first put into practice in the case of a woman with strangulation on the left side. Mr. Watson Cheyne, quite independently, employed the same method, and published his account of the operation in 1892. The hernia is exposed by an incision placed a little to the inner side of its centre, so that it is some distance from the femoral vessels. The bowel is reduced, the sac dissected up and opened, to make sure that the ring is clear, and its neck is then ligatured and the rest removed. A flap of the pectineus muscle and its fascia is then dissected up from below, care being taken that the femoral vein is not damaged. This flap is turned upwards, so that it completely occludes the crural ring, and is united by two or three kangaroo or silk sutures to Poupart's ligament and the lower part of the abdominal wall. The wound is dried, closed, and drained by means of a few strands of silk introduced at the lower part. The wound heals soundly in about ten days, and I have never met with a case of recurrence of the hernia.

Strangulated femoral hernia.—The strangulation is usually very tight and is produced by the firm resisting edge of Gimbernat's ligament, which will require free division. Owing to the tightness of the constriction opposite the ligament gangrene of the gut in this situation is not uncommon and is rapidly produced. More rarely the constricting band will be found to be the deep crural arch or the upper border of the saphenous opening. The constriction should be divided in an upward and inward direction, and if Gimbernat's ligament is to be cut the incision must be very carefully made, the knife not being pushed beyond its edge towards the abdomen for fear of wounding the obturator artery should it be taking an abnormal course. If this accident should happen the hæmorrhage may be controlled by the finger until the wound has been enlarged and the vessel tied; the artery always contracts considerably if it has been completely severed. If any difficulty is experienced in securing the vessel in the wound the surgeon may arrest the bleeding by passing an acupressure needle through the abdominal wall and under the artery, or he may cut down upon it by an incision directly above and parallel with Poupart's ligament and secure it near its origin.

In attempting taxis, the thigh must be slightly flexed and rotated in, and pressure must be made in such a direction as to push the hernia back along its path of escape. Thus, supposing the rupture has extended up towards Poupart's ligament, it must first be pushed a little downwards until it is brought opposite the saphenous opening, then backwards through this, and lastly, upwards along the canal to the abdomen. It should be remembered that taxis in cases of femoral hernia is especially dangerous owing to the relation of the neck of the sac to Gimbernat's ligament, which is sharp and unyielding.

UMBILICAL HERNIA

Congenital umbilical hernia.—At an early period of fœtal life the intestine lies outside the abdominal cavity, but becomes included within it as the body-wall closes. Sometimes this closure may to a large extent fail and the greater part of the gut and abdominal viscera may lie external to the cavity, being merely enclosed by a thin membrane; such a condition is incompatible with life. More usually a small knuckle of gut or a mere diverticulum, *e.g.* Meckel's, remains outside in the substance of the umbilical cord, and under such circumstances strangulation may be produced if the cord be ligatured too near the navel. These small herniæ usually undergo spontaneous cure in a few weeks, as the umbilical aperture closes.

It sometimes happens that, although there is no hernia present at birth, the umbilical cicatrix yields shortly after, especially if the child cries much and so increases the intra-abdominal tension. A small hernial protrusion is thus formed and is by no means an uncommon occurrence. It is easily repressed by the finger, and the umbilical ring is thereby demonstrated. All that is needed in these slight forms is the equable pressure of a pad of lint, which must be larger than the ring itself, and can be maintained in position by a strip of plaster or a binder. If the pad is merely made to fit the ring the closure of this is prevented and the hernia will increase in size.

Acquired umbilical hernia is usually met with in elderly women, especially those who have borne large families and whose abdominal walls are stretched and lax. The hernia may be enormous and may contain nearly all the intestine and the omentum; the latter is very likely to become adherent so that the tumour is partly or wholly irreducible; the aperture in the abdominal wall is more or less circular, and may be very large. The tumour is often distinctly lobulated and the contents are usually more or less adherent when the hernia has been present for some time. The covering consists of skin and fascia only and may be very thin. Umbilical herniæ often cause considerable discomfort and dyspeptic symptoms, are very liable to become incarcerated, and are not infrequently strangulated.

Treatment—**By truss.**—The patient must be accurately fitted with a stout, moderately unyielding, abdominal belt, fitted with a spring and pad to keep the hernia back if it is reducible, or to support it and prevent its increase in size if it is irreducible. A good deal of trouble is often necessary to obtain an apparatus which will fulfil its object without causing the patient undue discomfort.

It is important to carefully regulate the diet and bowels in view of the not uncommon occurrence of incarceration if these precautions be neglected (see p. 448).

Radical cure by operation.—This is only advisable when the hernia is small and reducible, and the patient not very fat or advanced in years. The operation is thus performed—two curved lateral incisions including a large oval portion of the stretched integument, but leaving sufficient to form an ample covering, are made from top to bottom of the hernia; the skin at the base on each side is then dissected up so that the sac and ring are exposed. The sac is opened at one side, but only to a sufficient extent to enable the surgeon to reduce the contents and deal with any bands of adhesion which may be present. When the contents have been reduced, the sac and oval portion of the integument are removed and the ring is sutured with kangaroo tendon. The abdomen must be supported by broad bandages, and when the wound is healed the patient must be fitted with a good belt for constant use.

Strangulated umbilical hernia is a very serious and fatal condition. If taxis fails to rectify the trouble operation should be at once performed. In most cases this is best done by making a small incision (preferably below) so that the margin of the ring is exposed; the sac at this point is opened sufficiently to allow the surgeon to investigate the condition of affairs. The ring is divided and the strangulation relieved, and then the wound is closed and dressed. If the hernia is small or of moderate size the operation may be conducted in the same way as for radical cure, but when it is very large, the more limited the procedure the better is the chance of recovery.

VENTRAL HERNIA

Ventral hernia is usually seen in the middle line between the umbilicus and the pubes, and is due to yielding of the linea alba. It is almost confined to women, especially those who have borne many children, and are advanced in years. It is occasionally seen at the linea semilunaris or at Pettit's triangle above the iliac crest (*lumbar hernia*). It may occur in any part of the abdominal wall in consequence of the yielding of a cicatrix, due either to operation or disease. The coverings are always thin, and the hernia is as large as in the umbilical form, but owing to the great size of the orifice strangulation is very rare.

Treatment.—Treatment by truss must be adopted on the same lines as recommended for umbilical hernia.

Radical cure is not advisable, and nearly always fails, but occasionally a small ventral hernia may be successfully operated on;

the decision for or against must be determined on the peculiarities of each case.

OBTURATOR HERNIA

In rare cases (almost confined to elderly women) a portion of ileum escapes through the opening for the obturator vessels and lies deep to the pectineus and adductor brevis muscles.

The presence of a hernia is usually only suspected when strangulation is occasioned, and even then its situation may not be ascertained, until laparotomy has been performed. Examination may cause pain and reveal a slight swelling and sense of resistance close to and just behind the adductor longus tendon; the pain may radiate along the obturator nerve. Examination *per rectum* or *vaginam* may be of use in making a diagnosis in suspected cases. Obturator hernia is likely to be mistaken for the femoral variety.

Operation.—The hernia must be cut down upon by an incision opening up the space between the adductor longus and pectineus, or if laparotomy has already been performed reduction may be effected from within the abdomen. If division of the structures at the neck is necessary, the exact position of the obturator artery should be ascertained if possible. Strangulation is very serious and nearly always proves fatal; moreover, there is a special tendency for this form of hernia to recur as radical cure is impossible.

SCIATIC HERNIA

Hernia through the sciatic notch is very rare; it may escape above or below the pyriformis muscle. It lies beneath the gluteus maximus muscle and may occasion considerable pain from pressure on the sciatic nerve. The diagnosis is extremely difficult owing to the depth of the tumour. If the patient is suffering from signs of intestinal obstruction, and there is a swelling and sense of resistance over the notch, the presence of hernia would be suspected, and it must be cut down upon from without or dealt with through a laparotomy wound. Sciatic hernia may be mistaken for a deeply seated abscess, a growth, or for aneurism of the gluteal or sciatic arteries.

HERNIÆ AT THE PELVIC OUTLET

Herniæ at the pelvic outlet are rare. They may be **perineal, pudendal, vaginal,** or **ischio-rectal.** The hernia forms an easily reducible tumour which is, however, kept up with difficulty. These herniæ must be diagnosed from solid or fluid tumours, and must be kept up by an appropriate apparatus. In very bad and troublesome cases an attempt may be made to effect a cure by cutting down on the tumour, reducing the contents, and ligaturing the neck of the sac.

DIAPHRAGMATIC HERNIA

Traumatic diaphragmatic hernia is referred to at p. 331, vol. ii.

The congenital form is dependent upon defective development of the diaphragm, so that the pleural and peritoneal cavities remain continuous at some part. The aperture of communication is nearly always on the left side and behind. The stomach, colon, small intestine, and even the spleen and kidney may lie within the pleural cavity, and if the opening is on the right side, a portion of the liver may be similarly placed. The lung on the affected side is undeveloped or compressed and the heart may be displaced. Children with this condition are usually stillborn or rarely survive long.

CHAPTER XXI

DISEASES OF THE RECTUM AND ANUS

Anatomy.—The rectum is about eight inches long and extends from the left sacro-iliac joint, following the curve of the sacrum and coccyx. The first part sometimes lies to the right of the middle line.

The tube is not sacculated but is dilated above the anus. The first part (to the middle of the third sacral vertebra) is surrounded by peritoneum and lies against the sacrum, left pyriformis muscle, and sacral plexus; laterally are the left ureter and internal iliac vessels; in front is the bladder or uterus, with coils of the small intestine. The second part extends to the tip of the coccyx; its upper half is covered by peritoneum in front and, where this is reflected, the tube pierces the recto-vesical fascia. Behind this part is the sacrum and coccyx; laterally the coccygei muscles, in front the trigonum vesicæ, vesiculæ seminales, and vasa deferentia; in the female the neck of the uterus and vagina are anterior, being separated from the gut in the upper half by the pouch of Douglas and small intestine.

The third part is destitute of peritoneum and surrounded by the levatores ani and cellular tissue. In front is the vagina, or prostate, bulb and membranous urethra, according to the sex.

The anal canal passes downwards and backwards, and is about one-half to one inch long; it is limited by the sphincter muscles above and below which surround it.

The lower three inches of the rectum are uncovered by peritoneum; in the male this distance may be increased by about half an inch when the bladder is fully distended.

Structure.—The rectum consists of an outer longitudinal and inner circular layer of muscle, the latter forming the internal sphincter at the lower end. The mucous membrane is loosely connected by the submucous coat and is thrown into folds when the rectum is empty. The folds of Houston are more or less transverse; one projects backwards from the anterior wall, just opposite the prostate, and two others are placed higher up and more laterally. At the anus there are longitudinal folds (columns of Morgagni) separated by small pouches. The mucous membrane consists of the crypts of Lieberkühn, supported by a delicate areolar retiform tissue, scattered through which are a few lymphoid follicles. The crypts are lined with columnar epithelium continuous with that of the surface; at the orifice of the anus the epithelium is squamous. The hæmorrhoidal arteries are derived from the inferior mesenteric, internal iliac, and internal pudic. The veins run in the submucous coat and then pierce the muscular; they join the internal iliac and inferior mesenteric (portal system).

The lymphatics join the lumbar glands.

Nerves are derived from the sacral plexus and the sympathetic.

PRURITUS ANI

Causes.—Pruritus is dependent upon local irritation and is often associated with some definite disease of the rectum or anus. Uncleanliness, pediculi, eczema (especially if gouty), and threadworms are common causes.

The irritation may be intense and is usually worse at night. From constant scratching the anal orifice and adjacent skin may be excoriated and an eczematous condition, if present, is thereby made much worse.

Treatment.—Any local cause must be removed. The parts should be kept clean and dry, and the irritation may be allayed by the use of ointments containing cocaine, benzoic acid, calomel, or carbolic acid. If the patient is gouty the diathesis must receive attention.

ACUTE PROCTITIS

Acute proctitis is a rare condition and may arise in connection with injury, the lodgment of a foreign body, some surgical procedure, dysentery, and rarely from gonorrhœal infection.

There is intense burning pain, with considerable tenesmus and straining and the evacuation of bloody mucous stools, which increases the local discomfort. There is marked constitutional disturbance, with elevation of temperature.

Treatment.—The pain may be allayed by morphia suppositories and the tenesmus by dilatation of the anus under an anæsthetic. Hot baths and enemata of hot water afford considerable relief and tend to subdue the inflammation.

If a foreign body is present it should of course be removed, and dysentery must be treated by large doses (20 gr.) of ipecacuanha.

In all cases the diet must be given in a fluid form and small quantities.

Gonorrhœal proctitis requires the employment of antiseptic lotions similar to those used in gonorrhœal vaginitis (p. 163, vol. i.).

PERI-RECTAL ABSCESS

Situation.—Acute or chronic abscess may occur in the submucous coat of the bowel close to the anus, in the connective tissue outside the muscular coat, in the ischio-rectal fossa, or beneath the skin at the anal aperture.

Causes.—Abscess in the ischio-rectal fossa may be due to injury, to cold, or to an extension of disease from the rectum, urinary tract, prostate, or pelvis. Suppuration in the immediate vicinity of the tube may be excited by the presence of a foreign body causing ulceration of the mucous membrane, or the body may, if sharp, *e.g.* a fish-bone, perforate the coats of the bowel and excite inflammation outside. Simple ulcer may also cause abscess and, doubtless, many small collections of pus close to the anal orifice owe their origin to ulceration set up in the small pouches between the columns of Morgagni, excited by small masses of hardened fæces which have lodged in the recesses. An inflamed pile or deposit of tubercle are also common causes, the latter being especially so in chronic cases. Suppuration may complicate cancer or stricture of the rectum.

Morbid anatomy.—An abscess may be internal or external to the sphincter ani muscle. The acute forms are usually quite localised and, if detected early and radically treated, do not tend to spread; in this respect chronic abscess is much the worst and is the usual precursor of fistula. By long and gradual burrowing sinuses may form at distant parts. Abscess may burst into the bowel, externally, or in both directions.

Signs.—Acute abscess presents unmistakable signs. The patient experiences some pain, which is aggravated by sitting or the action of the bowels. The part is red, swollen, hot, and tender;

ischio-rectal suppuration causes œdema before fluctuation can be detected. The temperature rises and the patient looks and feels very ill. In chronic cases the signs are less marked and the patient may not seek relief until the abscess has been present for some time, has burrowed widely, and opened on the surface in one or more places.

Treatment.—All abscesses must be freely opened and the highly offensive pus evacuated.[1] The cavity should be syringed out with boric acid or weak carbolic solution, and a loose plug of iodoform gauze or carbolic-oiled lint placed in it. The dressing should be frequently changed. Acute abscess will speedily heal and ought never to result in fistula.

In the case of chronic abscess the sac must be laid open and the wall sharp-spooned, since it is so frequently dependent on tubercle; if the abscess has already burst and the condition is practically that of fistula, it must be treated as described on p. 475.

FISTULA IN ANO

A fistula is the narrow track left by the persistence of a suppurating area due to chronic abscess. It is frequently of tubercular origin, but may originate from any of the causes exciting anal or ischio-rectal abscess; it also occasionally occurs in connection with malignant disease of the rectum.

Morbid anatomy. — A fistula is **complete** when there is an opening into the bowel and also externally (Fig. 151, *A*), **incomplete** when there is only one opening. Incomplete or blind fistulæ are of two varieties: (1) *blind internal* when the opening is into the bowel (Fig. 151, *B*); (2) *blind external* when it is on the skin (Fig. 151, *C*). Clinically these distinctions are unimportant. A *horse-shoe fistula* is one in which the sinus more or less completely surrounds the bowel but does not necessarily open into it. There

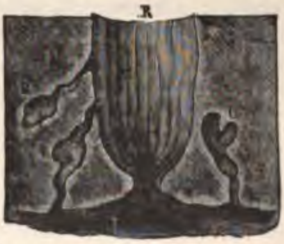

FIG. 151.—Diagram of the common forms of fistulæ in ano. *R*, rectum; *A*, complete fistula, dilated in the middle; *B*, blind internal fistula; *C*, blind external fistula, the sinus dividing at the upper end (Follin).

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[1] It is to be particularly noted that an abscess in close proximity to any part of the alimentary tract may contain intensely fœtid pus, and may even be tympanitic from the presence of gas, without there necessarily being a communication between its cavity and the lumen of the alimentary canal.

may be only one external opening, but sometimes there are more. The recognition of this condition is of great importance, yet it may be easily overlooked.

The extent of the fistulous track depends upon the original seat of the abscess; those dependent upon ischio-rectal abscess often extend widely and open at distant points (buttocks, scrotum, or penis) by numerous apertures; such tracks are external to the sphincter muscle. In most cases, the track of a fistula lies internal to the sphincter, or passes between its inner fibres; the mouth is close to the anus and may be concealed by its folds or by a small granulation; it is usually recognisable as a small papilla, into which the probe enters. The sinus itself is usually oblique and may be straight or tortuous; in long-standing cases the walls are dense and indurated and, if due to tubercle, are infiltrated by it. The internal opening of a complete fistula is about an inch, or rather more, from the margin of the anus, and is indicated by a small red papilla from which pus escapes. Extending beyond the internal opening the sinus may form a cul-de-sac outside the bowel.

Signs.—The patient may complain of repeated "boils" about the anus, which he has perhaps treated himself; the "boil" has burst, discharged, and ceased to pain, but has, as he supposes, been followed by others. This history is readily accounted for. A chronic abscess has formed and burst, but the narrow opening being temporarily closed by granulations or scabbing, the pus, re-accumulating behind it, has caused additional pain and tension until the latter overcame the obstruction, when temporary relief was again afforded. In other cases—and perhaps these are most usual—the patient complains of piles.[1] There is pain, especially on defæcation; it may also have been noticed that the surface of the fæces is coated with pus and blood, and further, that the linen is occasionally stained with pus.

Examination will reveal the position of the external opening and the extent of the mischief; if no opening be found externally, the rectal speculum must be introduced and an internal opening sought for.

Causes of persistence of the fistula.—The narrow track and its still narrower orifice prevent free drainage; added to this, the passage of fæcal matter into the track, and in some cases the presence of a foreign body, keep up the irritation. The movements of the sphincter muscle also prevent adequate rest. In tubercular cases the presence of the *materies morbi* is of itself sufficient to prevent healing.

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[1] A patient's statement that he has piles should always be confirmed by examination, for among the laity "piles" is a term loosely used for nearly all rectal trouble.

Treatment.—In all cases of abscess about the rectum or anus the occurrence of fistula ought to be prevented by free incision and drainage, coupled with the use of the sharp-spoon in tubercular cases; the wound must be made to close from the bottom. When fistula is present it must be encouraged to heal by counteracting those causes to which its persistence has been shown to be due. This is easily done by laying the sinus open into the gut, and in tubercular cases, or those in which the walls are indurated, the fistula must be sharp-spooned; if a foreign body be present it must of course be removed.

Operation.—A purge should be given over night and the bowel thoroughly emptied by enema on the morning of the operation.

The patient is placed on the side of the fistula, and a probe-director is gently passed along it and into the bowel through the internal opening if the fistula be complete; if incomplete, the probe is pushed through the mucous membrane when it has reached the end of the sinus, thus rendering the fistula complete. The point of the probe is now readily made to project at the anus and the structures are completely divided. If there are two tracts (horse-shoe fistula), both must be divided or cure will not result. If a cul-de-sac passes up by the bowel beyond the internal opening it need not necessarily be divided, but if long and narrow this should be done, it being remembered that the vessels increase in size higher up. Sharp-spooning, if necessary, can be easily effected. The bleeding is rarely a matter of importance.

In cases of blind internal fistula the procedure is the same, but the probe is passed from the bowel towards the skin, being for this purpose bent upon itself.

A morphia suppository is introduced, and a piece of oiled lint should be placed between the edges of the wound and replaced on the following day; if the dressing is left longer it becomes putrid, and septic absorption with high fever may follow. The bowels should be opened on the third day, and great care must be observed to maintain perfect cleanliness. A red-wash dressing placed in the bottom of the wound will stimulate the granulations and prevent healing at the surface before the deeper parts have filled up.

Healing is rapid at first, but it may be some time (usually a month or six weeks) before the granulating surface is completely covered with epithelium, since it is irritated each time the bowels act.

During the healing process every care must be taken that burrowing is prevented, otherwise cellulitis may be set up.

In cases of fistula complicating advanced pulmonary phthisis, no operation should be undertaken; but its performance is followed by good results if the lung condition be not severe.

The treatment of fistula by stimulating injections, hot wires, and the elastic ligature is now practically abandoned.

In those very severe cases in which fistulous tracts open at long distances from the anus and pass deeply among important structures, great trouble and difficulty are often experienced, as it is out of the question to slit up all the tracts.

FISSURE OF THE ANUS

Causes.—Fissure of the anus is more common in women than men. It may be due to actual tearing of the mucous membrane, as by the passage of hard scybalous masses, or may occur in connection with piles. Sometimes the fissure is syphilitic, and it not infrequently occurs in broken-down tubercular patients.

Anatomy.—The fissure is usually situated just within the anal folds at the posterior segment, a little to one side of the middle line.

The ulcer is longitudinal, quite short, and rather broader at the orifice of the anus than towards its upper end; it is usually well concealed between the folds of the anus, and may have a small pile near it (*sentinel pile*). A recent ulcer is of a bright red colour, quite supple, and readily bleeds if stretched; old ulcers are indurated and greyish in colour.

Signs.—The history is characteristic and usually conclusive. The patient complains of intense burning pain during and after defæcation; the pain is always severe, and may be so agonising that the call to stool is purposely neglected until it becomes imperious—necessarily with aggravation of the pain on account of the hardened fæces. In the worst cases the patient voluntarily starves in order to avoid defæcation. The pain may persist for minutes or hours, or the patient may never be quite free. The stools are occasionally streaked with blood.

The effect on the general health is marked; the patient looks ill, and becomes thin and anxious, with the ever-haunting dread of the necessity to defæcate. Examination without anæsthesia may be impossible, and if an attempt is made to introduce the finger into the rectum the sphincter spasmodically contracts, and the patient suddenly shrinks away with an expression of suffering. In less acute cases, if the buttocks are separated and the anal rugæ smoothed out while the patient strains down, the little fissure is easily detected.

Treatment.—Operation should be at once undertaken, and gives immediate and permanent relief. The patient having been completely anæsthetised, the thumbs are inserted into the anus which is then fully stretched, until the sphincter muscle is felt to give way; stretching must be continued for ten or fifteen minutes, when the muscle will be found to have lost all tone. If a pile is present it should be snipped off with scissors. In tubercular cases it is advisable to sharp-spoon the surface of the ulcer. A morphia suppository is now placed in the rectum, and the patient should be kept at rest in bed for three or four days, the bowels being opened (quite painlessly) on the morning of the third. This operation permits of healing by paralysing the sphincter, and so allowing complete rest; it often occasions considerable bruising, but no permanent loss of control over the sphincter.

Fissures which may occur in the course of secondary syphilis heal well without operation; the parts must be kept clean and dry, and should be dusted with calomel twice daily.

PROLAPSUS ANI—PROCIDENTIA RECTI

Causes.—Prolapsus ani is an exaggeration of the normal prolapse of the anal mucous membrane which occurs during defæcation. When the condition is pathological it affects the lower part of the rectum as well as the anus. Long-continued prolapsus may induce procidentia, in which the whole thickness of the upper part of the rectum is invaginated through the lower part and anus; this is a much more serious condition.

Prolapsus is more common in children and in advanced age, and at these periods seems to be due in the main to a natural laxity of tissue and weakness of the perineal body. It may be induced by anything causing irritation or increased straining, such as constipation, thread-worms, diarrhœa, phimosis, vesical calculus, enlarged prostate, or urethral stricture; or it may be due to direct dragging on the mucous membrane by piles or a polypus.

Signs.—At first the prolapse may be very slight, going back spontaneously and causing but little trouble; but if neglected it increases much in size, requires manual reduction, and may come down independently of defæcation, so that the patient cannot get about with comfort. As the prolapse increases in size the sphincter becomes more and more stretched, and the skin round the anus becomes lax and flabby; this loss of support tends to a further increase of the prolapse.

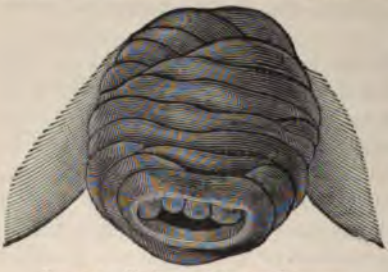

FIG. 152.—Prolapse of the rectal mucous membrane (Follin).

If the prolapse is small the mucous membrane is usually smooth, but if large it is thrown into folds arranged transversely round the central opening. Bleeding from the mucous membrane may occur, or it may become ulcerated. Occasionally the mass is strangled by the sphincter, and spontaneous cure by sloughing results.

Treatment.—If the cause can be removed the condition will soon disappear. In children it often happens that no obvious cause can be found, but by judicious and continued treatment the condition can nearly always be remedied without operation. The bowels must be regulated and laxatives given to ensure soft motions which can be passed without straining. During defæcation the buttocks should be separated by the nurse to support the perineum, and the child may pass his motion while lying on one side; after it the bowel, if it protrudes, must be gently repressed, and the rectum be washed out with cold water. The recumbent position should be maintained for an hour or more after a motion. Injections of infusion of quassia, alum, grs. 10 ad ℥i., matico, or sulphate of iron, grs. 3 ad ℥i., may prove serviceable and should be given a fair trial. The child's general health and tone must be improved; he should live well, spend plenty of time in the open air, and take sufficient exercise; tonics and cod-liver oil should also be given.

Mechanical contrivances are of little value. If the above treatment fails, the protruding bowel may be painted with nitric acid under anæsthesia; the superabundant acid must be removed and the bowel well oiled and returned. As an alternative the bowel may be superficially burned with the actual cautery drawn longitudinally along the mucous membrane at various places, and extending to the anal margin; the separation of the eschars is followed by granulation and contraction which may prevent further prolapse. Complete rest should be maintained for at least three weeks to allow of firm contraction. In severe cases of procidentia the prolapsed portion may be excised, care being taken not to damage the peritoneum, but should this occur it must be carefully sutured. The upper end of the bowel is united to the skin at the anus by points of silk suture, as in Whitehead's operation for piles. By this means I have cured a very large procidentia of twenty years' standing.

HÆMORRHOIDS

The veins of the hæmorrhoidal plexus are very prone to become varicose, since they run in the lax submucous tissue, and subsequently pierce the muscular coat; they are thus unsupported and liable to constriction during muscular contraction; moreover, the degree of distension of the vessels varies according to that of the rectum. The peripheral position of the veins as regards the caval and portal circulation is an additional reason for varicosity.

Causes.—Doubtless the tendency to piles is in many cases hereditary, and one not infrequently meets with severe cases in members of the same family occurring at an early age and without obvious cause. Any cause interfering with the proper circulation through the veins leads to chronic over-distension and ultimate varicosity. Among such may be mentioned chronic constipation, pregnancy, or the pressure of any tumour, want of sufficient exercise, and portal obstruction from whatever cause arising. Local congestion is also favoured by high living and luxurious habits of life, repeated irritation and congestion of the genito-urinary tract, the abuse of alcohol, and sitting on damp, cold seats.

As regards age, piles occur with increasing frequency with every decade of life, and are more common in women during the period of sexual activity.

Morbid anatomy.—When the piles are situated round the anus and are covered with skin, they are said to be **external**; when higher up, they are covered with mucous membrane and are called **internal**. In most cases there is a combination of the two forms—**intero-external.**

The structure of all piles is practically identical; there is a covering of skin, mucous membrane, or muco-cutaneous tissue, according to the situation. The substance of the pile is formed of a coil of dilated veins, a central artery, and connective tissue. The walls of the veins are thicker than normal and, owing to their tortuosity, the pile when cut across looks as if composed of small cysts filled with blood. From frequent prolapse the covering of the piles may become ulcerated. Piles may become acutely inflamed and suppurate; or being prolapsed and strangled by the sphincter, may undergo spontaneous cure by sloughing, bleeding being prevented by thrombosis of the veins. Owing to constant traction, piles induce a certain degree of prolapse of the mucous membrane.

The number of piles present in any case varies; there may be only one, or the whole margin of the anus may be surrounded by them; in the case of internal piles, more or less pedunculated masses may form a large bunch which frequently prolapses.

Whitehead has very properly insisted that the pile is but a tumour expressive of a general dilatation of the veins of the hæmorrhoidal plexus, and contends that unless the whole pile-bearing area be subjected to operative treatment by excision, the piles may return.

The so-called **capillary pile** is really a nævus; it is composed of numerous tortuous capillary vessels and resembles a raspberry in appearance; it bleeds copiously, sometimes incessantly, and causes considerable pain. In some cases the capillary pile becomes inflamed, and by the overgrowth of new tissue forms a dense, tumour-like projection, well supplied with vessels which may bleed profusely.

External piles—Symptoms.—When the pile first forms, the patient complains of constant aching pain, worse on defæcation, on movement, or on sitting down; so that he sits in a constrained attitude, on one buttock, and on the edge of the chair. He may complain of considerable local irritation, and feels that there is something at the margin of the anus, just within the grip of the external sphincter which, spasmodically contracting, adds to the discomfort. He derives temporary relief from emptying the pile by pressure and pushing it further within the grip of the sphincter. On examination there will be found a small, rounded, very tense, livid swelling, which may be emptied by pressure unless it be inflamed. In the latter case the local symptoms are much aggravated, and there may be some constitutional disturbance. Inflammation leads to thrombosis and perhaps abscess, which may burst and leave a fistula.

Under treatment all the symptoms usually subside, but sooner or later the patient will again suffer. Repeated attacks lead to considerable thickening about the pile; the muco-cutaneous covering becomes pendulous and forms tags round the anus, but the veins themselves may become more or less obliterated.

Treatment.—In ordinary cases the symptoms readily subside if the bowels are freely opened and kept acting by confection of senna, liquorice powder, or some similar preparation, coupled with rest and attention to the diet.

If the pile inflames it should be laid open and the clot turned out, hot fomentations being applied until the surrounding tumefaction has disappeared. In chronic cases when the anus is surrounded by pendulous tags of skin, or skin and mucous membrane, which give trouble and prevent cleanliness, these should be snipped off with scissors. In order to prevent a return of the trouble after one attack, the diet should be regulated; it must be unstimulating and simple, and alcohol must either be given up or taken in very moderate quantities; the daily action of the bowels should be secured by the use of confection of senna or some aperient water such as Carlsbad or Friedrichshall, and sufficient bodily exercise enjoined.

Internal piles—Symptoms.—The patient usually suffers from constipation and complains of a sense of fulness about the rectum. The call to defæcate is frequent, but the act is not followed by complete relief. There is often considerable irritation and tenesmus, with mucus and blood with the motions. During defæcation the piles prolapse; a frequent repetition of this causes them to become more or less pedunculated, and by continued traction leads to prolapse of the mucous membrane and relaxation of the sphincter, in consequence of which the prolapse is increased. Protrusion of the piles may lead to ulceration of the mucous membrane, entailing considerable aggravation of the pain and local discomfort. Sometimes the protruded mass is tightly grasped by the sphincter, and this may lead to inflammation or actual sloughing of the piles, accompanied by great pain, fever, and constitutional disturbance.

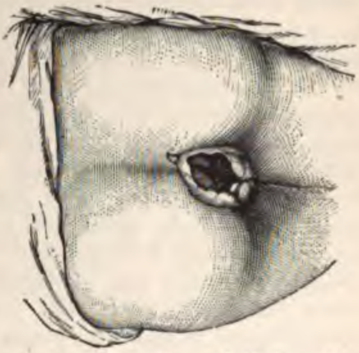
FIG. 153.—Internal hæmorrhoids (Bryant).

Hæmorrhage is a frequent symptom; at first slight in amount, the quantity lost at each recurrence becomes greater, and the patient may never have a motion without losing blood; he consequently falls into a state of profound anæmia and ill-health.

The blood is of a bright colour, coats the stools, and by coming away after the motion scatters over the pan; bleeding from higher up the intestine is easily recognised by the blood being more or less mixed with the fæces, and of a dark colour and tarry appearance.

After an attack of hæmorrhage the local trouble is for a time in some degree relieved.

The physical and mental worry occasioned by piles is sometimes extreme, seriously undermining the patient's health, whose thoughts are centred on the rectal trouble.

Before an examination of the rectum is made, the patient's bowels should be thoroughly opened by a purge over-night and enema in the morning, and he should be directed to sit over a bidet of hot water for about ten to fifteen minutes and bring the piles down by moderate straining. The protruded piles appear as tense, livid, soft masses, often more or less pedunculated, and perhaps ulcerated on the surface.

Treatment.—Much may be done to relieve the patient by palliative treatment, but in cases causing great trouble and mental anxiety some operative measure is always advisable, unless the piles are dependent upon some general condition, *e.g.* portal or cardiac impediment to the circulation. The patient should be directed to live quietly and plainly, to avoid all highly seasoned and rich dishes and to drink only a little light claret. Moderate exercise should be taken, but horse or bicycle riding is very likely to cause local congestion and increased trouble. An action of the bowels should be secured daily by the use of laxatives if necessary; the best for this purpose are the confections of senna, sulphur, or black pepper, Carlsbad salts, or Friedrichshall water. The patient should be instructed to encourage the bowels to act the last thing at night—a habit not difficult to acquire, and having the great advantage of being followed by hours of complete rest in the recumbent position. After an action about half a pint or more of quite cold water should be injected into the rectum, the piles having been carefully replaced if they have come down; the water is retained for a few minutes and then slowly expelled. The use of hamamelis or astringents, *e.g.* ferri sulph., grs 5 ad ℥i., will be necessary should there be any bleeding.

If it is decided to resort to operation, the patient should be kept at complete rest for a few days, during which the above treatment must be carried out. The day before the operation a purge of castor oil should be given, followed in the morning by an enema to ensure complete emptiness of the bowel. After the patient is anæsthetised, the anus should be fully dilated as described at p. 477. This should always be done before any rectal operation; it facilitates manipulation and does away with subsequent spasm of the sphincter, which regains its tone in four or five days.

Of the many operations for piles each has its staunch advocates and opponents, and it may be said that no one operation is suitable for all cases.

Ligature.—The pile is seized in ring-forceps and drawn well down, the mucous membrane at its base is snipped through with scissors, and the pile ligatured with silk and cut off about a quarter of an inch from the ligature. Each pile is successively ligatured. The seat of operation is dusted with iodoform, and one end of each ligature is left hanging out from the anus. Separation of the ligatures occurs in about eight days.

When the ligatures separate, secondary hæmorrhage may occur, and it is important to note that the blood escapes into the rectum rather than externally; thus the extent of the bleeding may remain unsuspected until the patient passes a large quantity of black coagulated blood.

If hæmorrhage occurs the patient should be anæsthetised and the vessel secured if it can be found; otherwise a petticoated tube must be inserted and the petticoat well distended with wool.

Ligature has the advantage of being easy and rapid, but it leaves a sore patch in the rectum, and the ligature, becoming saturated with septic material, may excite inflammation. It is not to be recommended, except, perhaps, where there is a single pile.

Crushing is advocated by some. The pile is seized and drawn within the specially constructed clamp and cut off after this has been tightened. The method is but little used and has nothing to recommend it.

Clamp and cautery.—The pile is seized with forceps and the clamp is applied to the base and firmly screwed up. The pile is then removed by the cautery at black heat and the clamp slowly loosened to see if any bleeding occurs; should it do so the clamp is again tightened and the cautery reapplied. Each pile is successively treated. This method leaves a sore patch in the rectum, which may be the seat of secondary hæmorrhage, and takes a long time to heal. It often causes considerable pain. The clamp and cautery may be used when there are only one or two small piles, but in bad cases should not be employed; treatment by ligature is preferable.

Galvano-puncture is useful in cases of capillary or nævoid piles.

Excision by Whitehead's method is undoubtedly the best and most scientific way of removing piles, and should be used in all cases in which they are extensive. Whitehead, to whom we owe this operation, says: "Without doubt the hæmorrhoidal condition is marked by special protuberances at certain points . . . but the essential fact remains that, though possibly concealed by these masses, there are minute venous radicles behind and between the main tumours. They are now as small as their larger neighbours once were, but let the latter be removed by clamp or ligature, and the apparently insignificant venules will dilate and take their place; the very removal, perhaps, affording room for growth, and whilst taking off external pressure, leaving the tension within increased. It is on the removal of these rudimentary piles that the permanence of the cure and the future welfare of the patient depend; and I contend that the operation of excision alone satisfactorily accomplishes this object."

The operation is thus performed:—

The bowel having been previously emptied by purge and enema, the patient is anæsthetised and placed in the lithotomy position. The anus is fully dilated and the sphincter paralysed. The mucous membrane is divided with scissors where it joins the skin, and with the attached hæmorrhoids is quickly separated by a blunt instrument from the bowel as high as the internal sphincter and pulled well down. Care must be taken that no skin is sacrificed, otherwise there may be some subsequent contraction at the anus.

The membrane is next divided transversely above the piles in successive stages, and the cut edge above is attached at once to the cut margin of the skin by fine silk sutures. All bleeding is arrested by torsion.

At the conclusion of the operation the upper end of the mucous membrane and skin will be found to be completely in apposition, and healing by first intention will readily occur.

Whitehead recommends the use of a belladonna suppository (2 grs.). The parts should be dusted with iodoform and a T-bandage applied. An ice-bag may be applied outside this for a few days, and on the fourth the bowels should be acted on by castor oil.

Whitehead claims for this procedure—and those who have given it a fair trial will agree with him—that it is easy of performance, effects a permanent cure, is practically devoid of risk, is painless, and is not followed by secondary hæmorrhage.

After any operation for piles, a tube left in the rectum allows the escape of flatus, and should bleeding occur, the blood will escape by it externally instead of accumulating in the rectum.

After-treatment of operations for piles.—The patient should be kept at rest in the recumbent position and the parts kept scrupulously clean by sponging with boracic acid solution after an action of the bowels and by dusting with iodoform, the unpleasant smell of which may be partially concealed by the admixture of coumarine or coffee. The bowels should be opened on the morning of the fourth day by a dose of castor oil or liquorice powder. Pain may be relieved by the use of morphia or belladonna suppositories, or by the application to the anus of a sponge wrung out of very hot water. If, as sometimes happens, retention of urine follows the operation, the patient should be directed to try and pass water in the knee-elbow position; failing this the catheter must be used.

For the first few days the diet must be fluid, but as soon as the bowels have acted, more substantial food may be given.

Should secondary hæmorrhage occur it must be treated as described under Ligature (p. 483).

NON-MALIGNANT STRICTURE OF THE RECTUM (FIBROUS AND SYPHILITIC)

Simple fibrous stricture is usually met with in the lower three inches of the rectum, but is not limited to that region. This form of stricture may be due to contraction following dysenteric ulceration, but may also follow the destruction excited by the impaction of a foreign body, injury of, or operation on the rectum and anus, and occasionally phthisis; in most cases it is due to syphilis.

Syphilitic contraction and stricture of the rectum is much more common in women than men, and usually occurs between the ages of thirty and forty. The process is analogous to the interstitial fibroid change met with in the liver and other viscera, and always affects the lower part of the rectum, frequently extending from the anal canal. In the early stages there is diffuse fibroid infiltration of the submucous coat, affecting the entire calibre of the intestine and extending upwards for two or three inches. After some time the mucous membrane, which is at first quite unaffected, becomes ulcerated; the irregular ulcers are sharply cut, ashy-grey in colour, with a sloughing base, and although there may be some attempt at granulation, healing rarely occurs. The destructive process may extend to the peri-rectal structures leading to suppuration and the formation of fistulous tracks which may burrow by the side of the gut, open into the vagina or on the surface of the buttock or perineum. The increasing infiltration and contraction of the new tissue leads to rigidity of the wall of the bowel and considerable narrowing of its lumen; the stricture may be irregular owing to unequal distribution of the fibroid tissue.

The gut above a stricture is dilated and the walls hypertrophied; the mucous membrane is often the seat of circular ulcers due to the irritation of retained fæcal matter, the presence of which excites catarrh with a considerable flow of mucus.

General symptoms of stricture.—If stricture is preceded by ulceration the patient will, during the progress of the latter, complain of considerable heat or burning pain with marked tenesmus and diarrhœa. He passes fæcal matter with bloody mucus, pus, and material like unboiled white of egg. There is a frequent call to defæcate which aggravates the local discomfort, but leaves a feeling as if something was still retained. The symptoms often improve towards the end of the day, and may have a distinctly intermittent character should the ulcerative process be temporarily held in check by treatment.

When contraction has occurred the symptoms indicative of stricture make their appearance. There is gradually increasing difficulty in obtaining an action of the bowels, and the patient may have several calls to stool before he is completely relieved. Constipation and diarrhœa alternate, and when questioned the patient may say that his bowels instead of being confined are too freely open, a statement which should never lead the medical attendant astray. This spurious diarrhœa is evidence of constipation as dribbling of urine is evidence of its retention. The stools become altered in shape, they may be flattened, ribbon-shaped, very narrow like a pipe stem, or come away in small scybalous masses like rabbits' fæces mixed with mucus, pus, and blood.

Pains about the sacral region and loins, and abdominal distension with colicky pains are common, and should always excite suspicion. The general health suffers materially; the patient loses strength and flesh, becomes much depressed and very anxious. In cancerous cases the pain is usually great, and may extend along the nerves of the sacral plexus; the amount of bloody mucus discharge is usually more than in non-malignant cases, and as the growth invades surrounding parts there may be signs of its affecting the vagina, bladder, or urethra.

Physical examination by means of the finger and speculum, if necessary, will readily reveal the situation and extent of the lesion. Syphilitic stricture is always situated at the lower part, frequently extends to the anus and involves the whole circumference of the gut. Simple fibrous stricture is also usually in this situation, but may occur in any part of the gut. Cancerous stricture may attack any part, but is most common within three inches of the anus; if the finger cannot reach it, or if it cannot reach the upper end of the stricture, the patient should be directed to cough, by which act the gut is forced downwards, and the stricture may be felt to slip over the finger like a ring.

If a stricture is so high up that it cannot be felt by the finger, a bougie may be used, but it must be very carefully introduced for fear of damaging the bowel, and is rarely to be recommended. A source of fallacy lies in the folds of Houston against which the bougie may impinge, and its further progress being arrested the surgeon may think he has reached a stricture; this may be avoided by using a hollow bougie, and when it is arrested water may be injected through it so that the bowel may be fully distended and the onward passage of the bougie facilitated.

Treatment of simple stricture.—The palliative treatment is the same as that necessary in cases of cancer (see p. 489). In cases of syphilis anti-syphilitics prove useless when contraction is present, but if the case is in the stage of ulceration, they should be given and the rectum syringed out with a solution of perchloride of mercury 1:5000. If the surface of the stricture is much ulcerated so that mechanical dilatation is impossible owing to the pain caused, an attempt must be made to get the ulcers to heal before bougies are passed, but unfortunately this is very difficult, and practically complete healing rarely occurs. Suppositories containing iodoform or boracic acid should be used twice daily and cocaine may be added if the pain be great. It is sometimes a good plan to confine the bowels for a week or ten days by the use of opium.

The rectum should be washed out daily with cold water after the bowels have acted. The stricture may be gradually dilated with well-oiled vulcanite or silk tapering bougies which must be passed with the greatest care, especially if the stricture is high up. The bougies, gradually increasing in size, should be passed daily, and retained in position for a few minutes. A sponge or laminaria tent may be first used if the stricture is tight, and should be left in for about twelve hours, the patient being given morphia if much pain results. By the daily passage of a full-sized bougie the patient's condition will be materially improved, and he should be taught to pass the instrument for himself. This is best done in the following manner:—The patient stands up, bending slightly forwards and having well-oiled and slightly curved the bougie, conformably with the pelvic curve, he passes it from the front between his legs; after a little practice he will learn to do so with ease.

If the stricture does not yield sufficiently under dilatation and is situated low down, it should be completely divided backwards, all the structures being cut through to the tip of the coccyx (*linear proctotomy*); this procedure is quite safe and gives great relief; as the surface granulates a full-sized bougie must be passed daily to prevent recontraction.

In suitable cases proctectomy may be performed as in cases of cancer. Failing these methods colotomy must be resorted to in bad cases.

CANCER OF THE RECTUM—MALIGNANT STRICTURE

Columnar epithelioma of the rectum usually occurs in men after forty years of age. The growth may affect any part of the tube, but is most commonly situated within three inches of the anus, and tends to involve the whole circumference of the gut. It is distinctly circumscribed, being limited above and below by a raised, rounded, and everted margin, so that on examination the end of the stricture may feel something like the os uteri. The surface of the growth is ulcerated and depressed below the margin. At first the mass is freely movable, but as growth proceeds it becomes fixed to the surrounding parts and the cancer gradually invades the vagina, bladder, and prostate or urethra, and establishes fistulous communications with them. It may also spread to the peritoneum, the muscles of the pelvic floor, the lumbar glands, the liver, and to the glands in the groin if the disease affects the anus. If suppuration is excited, fistulous channels may open on the buttocks and round the anus, or the pus may burrow up between the sacrum and rectum or by the side of the latter.

Columnar epithelioma is composed of columnar epithelium growing into the submucosa and deeper parts in the form of tubes, precisely like the ordinary crypts of Lieberkühn met with in the intestine; the connective tissue is infiltrated with small round cells, and the growth spreads to the glands by means of the lymph paths.

Scirrhus and colloid cancer have sometimes been met with, and squamous epithelioma occasionally occurs at the anus.

Signs.—As in many other rectal diseases, the patient often applies for the relief of piles, from which he thinks he has been suffering for some time, a supposition seeming to him evident from the loss of blood which he has probably suffered. In the early stages, before the growth has produced sufficient narrowing of the gut, or caused much trouble from actual stricture, there is pain along the loins, in the sacral region, and perhaps down the thighs; the pain is made worse by defæcation, and is sometimes very severe. There is irritation and a sense of fulness and discomfort about the rectum, tenesmus, alternating constipation and diarrhœa, bloody mucus, and a fœtid purulent slimy discharge. As the disease advances, the signs of stricture become marked (see p. 486); the local trouble increases, and may be complicated by suppuration or by invasion of the vagina, bladder, prostate, or urethra. When the growth is situated high up, complete acute obstruction may be caused by partial intussusception. Dyspeptic symptoms and flatulence, with distension of the abdomen (varying in degree from time to time), add to the patient's sufferings. On examination, the growth will usually be easily felt; the finger should be passed through the stricture to see how far up the bowel is diseased, and it should be clearly ascertained whether or not the portion of gut affected is freely movable, both of these points being of great importance in deciding the question of removal by operation.

Treatment.—Unfortunately most cases of cancer of the rectum are unfitted for removal, either because the growth is situated too high up, or because the patient has, under the impression that his trouble is merely piles, neglected to apply for relief until the disease has progressed too far.

If the disease does not extend more than five inches from the anus, if it be freely movable and there are no signs of involvement of adjacent structures, or of secondary deposits in the glands or liver, the rectum may be removed, but under other circumstances palliative measures only can be adopted.

The diet must consist of easily digested food, which leaves but little solid residue, and it should be given in small quantities at a time. Soups, eggs, fish, poultry, and game are the best; meat must be given sparingly only, and veal, pork, and vegetables are best left alone as they are indigestible.

The bowels must be kept open by mild laxatives or enemata, but strong purgatives must not be given since they occasion considerable tenesmus and pain, and may lead to rupture of the gut above the constriction, or to partial intussusception. Much relief is obtained by washing out the bowel with boracic acid solution (grs. 2 ad ℥i.), or Condy's fluid. Morphia by suppository or hypodermic injection should be used if there is much pain. As regards the performance of colotomy, it may be generally stated that this should be postponed as long as possible, and in the majority of cases need never be performed; it may be imperatively called for (1) if signs of acute or subacute obstruction set in, (2) if the pain and discharge are great, or (3) if fistulous communications form with the vagina, bladder, or urethra. Its early adoption is urged by some with a view to diminish the rapidity of the growth of the cancer by doing away with the irritation of the passage of fæces over it, and to diminish the local discomfort; but it is very much open to question if these considerations (even assuming the objects are attained) are sufficiently pressing to warrant the surgeon inflicting on a patient suffering from a mortal disease the unspeakable annoyance and mental distress which an artificial anus occasions; I feel sure that most people would elect to put up with the inconvenience the presence of the cancer causes rather than minimise it by taking on themselves additional trouble of such a nature as colotomy involves.

Colotomy in certain cases may render the patient's end less miserable, but its performance, merely with the view of retarding the growth of a cancer, which must inevitably prove fatal in a very short time, is a questionable benefit.

Excision of the rectum or proctectomy.—In the male about five inches of the rectum may be removed without much danger of wounding the peritoneum, provided due care be taken. The peritoneum extends to within about three and a half inches of the anal orifice, but if the bladder be distended it is about four inches distant; in the female it extends somewhat lower, and hence is more likely to be opened in the operation. The patient is anæsthetised and placed in the lithotomy position; if a male, the bladder should be distended with about twelve ounces of weak boracic solution, so that the peritoneum is drawn up. The anus having been fully dilated, the left index finger is passed into the rectum to the tip of the coccyx, and a bistoury guided by it is used to divide all the structures from this point backwards. The junction of the skin and mucous membrane is now divided with scissors all round the anus, beginning behind; the lower part of the gut, where it is blended with the levatores ani, is quickly separated with scissors, and higher up with a blunt instrument. During the separation in front care must be taken not to injure the vaginal wall, or the urethra in the male; an assistant's finger in the former and a sound in the latter will materially help the surgeon to avoid these accidents. If the vagina is involved it must be removed clear of the disease. As the point of reflection of the peritoneum is reached, this should be gently pushed upwards as far as necessary, and should it be accidentally opened the rent must be at once sutured with chromic catgut. As soon as the gut has been well separated, it must be drawn down, and slit up anteriorly, so that the extent of the growth may be plainly seen; the bowel is divided well beyond the cancer with scissors or the Pacquelin's cautery. If the former are used, the vessels must be secured as they are divided. The operation being completed the parts should be dried and cleaned, dusted with iodoform and packed with gauze, through which a tube may be inserted into the gut. The after-treatment consists in rest and perfect cleanliness, ensured by free douching and the use of iodoform, especially after an action of the bowels.

If care has been taken to thoroughly empty the bowels before the operation, no attempt need be made to procure an action for a week or ten days afterwards, by which time the wound will be granulating rapidly. When healing is sound the patient has very good control over his motions unless he gets diarrhœa, when considerable trouble may be experienced. This may be counteracted by attention to the diet and the use of charcoal, bismuth, or some form of astringent mixture.

Contraction at the anal orifice must be prevented by the daily use of a bougie, but should the patient have allowed the narrowing to become great, the cicatrix may require division backwards towards the coccyx.

It sometimes happens that after operations on the rectum, especially in nervous patients, there may be some mental excitement, even amounting to mania; this usually subsides in a few days under the use of bromides.

Kraske's operation.—Littlewood recommends placing the patient in the prone position, raising the pelvis, and allowing the knees to rest on a chair. Kraske's incision, which may be modified according to circumstances, extends from the second sacral spine to the anus. The soft structures on the left side are reflected, and the coccyx, and, if necessary, some portion of the sacrum is removed, care being taken that the sacral nerves are not damaged or the sacral canal opened. The gut being thus fully exposed is detached from its surroundings and slit up posteriorly so that the extent of the disease is seen, it is then divided above, and, if possible, the lower part of the bowel is preserved. The peritoneum will probably be opened, and must be kept from contamination and sutured with chromic gut. If the lower part of the bowel is saved it may be united to the upper by silk over a Robson's bobbin. The wound is closed and drained, and the bowels confined for ten days.

Preliminary colotomy is advocated by some surgeons, but as a routine practice is not to be recommended; when the stricture is very tight, colotomy may be advantageous.

RECTAL OBSTRUCTION BY PRESSURE FROM WITHOUT

The rectum may be seriously compressed by tumours springing from the pelvic walls, or from the uterus or ovaries which have become wedged in the pelvic cavity. Simple enlargement or malignant disease of the prostate may produce a similar result, and I have seen complete obstruction, necessitating colotomy, produced by a large pelvic hæmatocele. Cicatricial tissue, the result of pelvic cellulitis, may cause some narrowing of the intestinal canal.

The walls of the gut are unaffected unless the pressure be due to some malignant growth which gradually invades them. The intestine dilates and hypertrophies above the seat of obstruction, and the mucous membrane may be the seat of stercoral ulceration from the irritation of retained scybalæ.

Signs.—The signs are those of rectal stricture, the cause of which is easily discernible by examination.

Treatment.—The cause of the obstruction should, if possible, be removed; thus a prolapsed and wedged ovarian tumour must be removed by laparotomy. In most cases, however, removal of the cause is impossible, and palliative measures must be adopted. The food must be light, nutritious, and of such a nature that but little solid residue remains, and the bowels must be regulated by saline aperients. If the obstruction is becoming serious, colotomy will be necessary.

INNOCENT TUMOURS OF THE RECTUM

Adenoma.—A tumour mainly composed of hypertrophied crypts of Lieberkühn, and from gradual traction on it becoming pedunculated (Fig. 154), is not uncommon in children, forming one variety of the so-called polypus. The tumour is usually small, and there may be a pedicle over an inch in length, which is usually attached just within the sphincter.

Fibroma is to outward appearance, and in the symptoms it occasions, very similar to an adenoma. It is smooth on the surface, dense in consistency, and attached by a pedicle. Occasionally these tumours are very vascular.

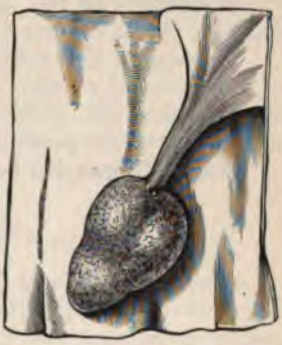

FIG. 154.—Adenomatous polypus of the rectum (Follin).

Papilloma or villous tumour.—This is a rare form of tumour, and may attain a considerable size. It looks like the head of a cauliflower, and is composed of overgrown papillæ and crypts of Lieberkühn, and is covered by columnar epithelium. These tumours may be the starting-point of epithelioma. Sometimes they are very numerous, and extend throughout the whole of the large intestine.

Papillomata of the anus are exactly like the warts met with about the vulva or penis, and are covered with squamous epithelium.

Symptoms.—All the above tumours present a train of clinical signs similar to those caused by internal piles. There is a frequent desire to defæcate, but the act leaves something to be desired and the patient is conscious of something being left behind. Tenesmus and bloody mucous diarrhœa may be present, especially in the case of multiple papillomata. A pedunculated tumour may be prolapsed and held tightly by the sphincter; it then becomes congested, inflamed, and painful, and may separate by sloughing. Examination of the rectum will reveal the presence of the tumour.

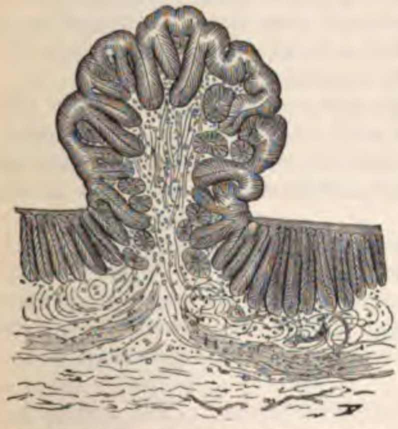

FIG. 155—Structure of a rectal papilloma (Follin).

Treatment.—The growth should be seized with forceps and twisted off, but if it is very vascular the pedicle should be ligatured after the mucous membrane round it has been snipped through. The parts should be dusted with iodoform and the patient kept quiet for a few days.

Papillomata of the anus may be snipped off with scissors, or removed by the cautery if they are very vascular.

Nævus of the rectum is sometimes met with in the form of the so-called capillary pile (see p. 480). It often causes considerable pain with profuse and persistent hæmorrhage. It is best treated by galvano-puncture or nitric acid.

Nævo-lipoma has been met with.

RECTO-VESICAL AND RECTO-URETHRAL FISTULÆ[1]

A fistula may form between the rectum and urinary tract as the result of injury, operation on the bladder or ulceration, but is usually consequent on the invasion of both by a malignant new growth. Very similar signs may be caused by an artificial communication between the bladder and some portion of gut higher up due to involvement by cancer. In some cases, the patient complains of a constant dampness about the anus, especially accompanying micturition if the fistula is connected with the urethra, or he may pass foul urine with a distinctly fæcal odour, or gas may escape from the urethra with the urine or independently of it. Examination of the urine will show that it is unhealthy; it is often ammoniacal and contains fæcal matter; microscopically undigested vegetable matter may be detected.

Examination of the rectum will reveal the presence of the fistula, especially if fluid be forced into the urethra or bladder; should this not be the case, it may be concluded that the artificial opening is between the bladder and some higher portion of the intestine.

Treatment.—If the fistula is dependent on cancer colotomy is the only remedy and may give much relief. In other cases an attempt should be made to pare the edges of the opening and close it with silkworm gut sutures, the bladder being drained for a few days, during which the patient is kept in the prone position.

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[1] Recto-vaginal fistula is referred to on p. 648.

CHAPTER XXII

Diseases of the Urinary Organs

The Urine

Normal urine, when first passed, is a pale, amber-coloured, acid fluid (due to acid phosphates) containing about $3\frac{1}{2}$ per cent solids, of which 2 per cent is urea and the remainder salts—notably phosphates, chlorides, and sulphates. Its specific gravity varies from 1015 to 1025. There is no deposit.

On cooling, a slight flocculent deposit of mucus may form and lithates may be precipitated. When decomposition sets in urine becomes alkaline, strongly ammoniacal, and turbid from deposition of phosphates. Phosphates are re-dissolved by the addition of an acid, *e.g.* nitric, lithates by warming the fluid. An adult secrets about fifty ounces of urine daily, a child considerably less; up to the age of about twelve the normal amount of urine is obtained in ounces by doubling the child's age in years—thus a child of six passes about twelve ounces.

Pathological states of the urine—Alterations in amount.—The quantity of urine is *increased* in diabetes mellitus and insipidus, and in chronic renal disease with increased arterial tension; it is *diminished* by acute renal disease, by destruction of the renal substance (especially if the ureter is blocked), and as the result of fever; temporary diminution is met with in cases of intestinal obstruction, and profuse loss of fluid by sweating, vomiting, or diarrhœa.

Alterations in specific gravity.—The specific gravity of urine is much *increased* in diabetes mellitus; it is also raised in cases of fever when the urine is scanty and concentrated, and when it contains much albumen, blood, or pus; it is *diminished* in diabetes insipidus and chronic interstitial nephritis.

Alterations in colour.—When the urine is abundant in quantity it is usually pale in colour and may be like water, conversely it is high coloured when scanty and concentrated. In chyluria the fluid is milky. Admixture with bile, blood, pus, and certain drugs give characteristic colour changes. Blood gives varying shades of red, or a smoky dark-brown colour; bile, brownish-green; pus, yellow or yellowish-green. Urates in excess give the urine a pink tint. Melanin may be passed in cases of melanotic cancer of the kidney or other parts. Carbolic acid, salol, guaiacol, and some other drugs (when absorbed from wounds or taken in excess) make the urine a dark greenish-black colour. Rhubarb and senna may make the urine red; the colour is deepened by alkalinity and changed to yellow on the addition of acids.

Alterations in reaction.—The normal acidity may be increased by an excessive meat diet. The urine becomes alkaline after standing, owing to the decomposition of urea and the formation of ammonium carbonate. It may be alkaline when passed, owing to the presence of disease in the bladder or kidneys with associated decomposition of urine.

Alterations in smell.—Putrid urine has an offensive ammoniacal smell; it may sometimes be fæcal when there is an entero-vesical fistula.

In diabetes mellitus the urine has a faint, sickly, sweet odour.

Certain resinous drugs, *e.g.* copaiba, may be distinguished by the smell of the urine, and turpentine gives it the odour of violets.

Alterations in transparency.—Urine may be rendered turbid by precipitation of phosphates or lithates; the former are redissolved by acids, the latter by heat. Chyluria, hæmaturia, pyuria, and admixture of mucus also render it turbid.

Alterations in the quantity of urea.—Normally about 2 per cent (480 grains in 50 ounces) of urea is passed daily. The quantity is increased by a nitrogenous diet and by excessive tissue change such as occurs during fever. Diminution of urea may be due to diminished nitrogenous food and is also met with in liver disease; it forms an important evidence of renal mischief and serves as a guide of great importance to the surgeon as to the state of the kidneys. The amount of urea may be estimated by Gerard's ureometer, but the specimen must be taken from a mixed quantity of urine passed during twenty-four hours, as the amount of urea varies during the day. A rough estimate may be made by taking the specific gravity of the twenty-four hours' urine and dividing the two final figures by 10; thus a specific gravity of 1020 would give 20 ÷ 10 = 2 per cent urea.

Excess of crystalline deposits.—Uric acid (Fig. 156) is often deposited as a "cayenne pepper" sediment in the urine of the gouty or over-fed; it is also present during fever and in leucocythemia. Urates of soda and ammonia (Fig. 157) may be deposited as a brick-dust sediment when the urine cools; they are quickly re-dissolved by heating.

Phosphate of calcium and ammonio-magnesium phosphates (Fig. 158) are deposited in alkaline urine, and when they are present in excess. Phosphates are always met with when the urine decomposes, and also in febrile attacks. Oxalate of lime (Fig. 159) is passed in considerable quantity in the urine of some people, especially such as suffer from dyspepsia, take little exercise, and live largely on a vegetable diet.

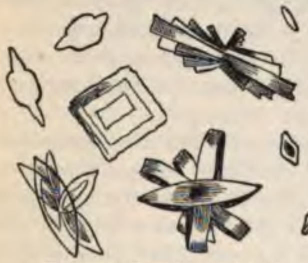
FIG. 156.—Crystals of uric acid.

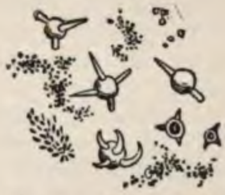
FIG. 157.—Crystals of urate of ammonium and amorphous urates.

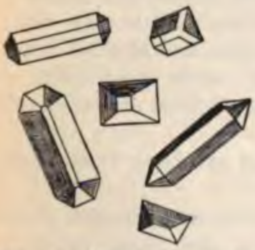
FIG. 158.—Crystals of ammonio-magnesian phosphate.

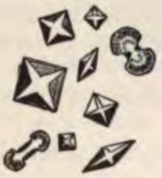
FIG. 159.—Crystals of oxalate of lime.

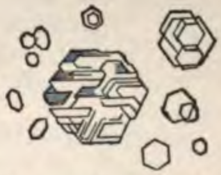
FIG. 160.—Crystals of cystine.

Sulphates and chlorides are constantly present in normal urine. Xanthin, cystine (Fig. 160), leucin, tyrosin may all occur.

Albuminuria.—The presence of albumen may be detected by boiling acidulated urine; if a precipitate remains it consists of albumen. The cold test is more delicate; a little nitric acid is put into a test-tube and some urine is poured down the side of the tube, so that the two liquids meet without mixing; if albumen be present there will be a hazy ring where the fluids meet. If the urine contains mucus the ferro-cyanide of potash (5 per cent) and acetic acid test should be used; this throws down albumen but clears up the mucus. When the albumen has been precipitated by boiling or by the last test, the tube should be put aside for some hours to allow the precipitate to settle, when the proportion it bears to the total column of fluid will give a fairly good estimate as to the quantity of albumen being passed. Albuminuria may be due to disease of the renal substance or to congestion from impeded venous circulation, such as may occur in disease of the heart, lungs, or liver, or from direct pressure on the veins.

Albumens are also present in the urine when it contains pus or blood, and if, as in a diet composed chiefly of eggs, albumen is absorbed from the stomach before it has been converted by digestion.

Pyuria.—Urine containing pus is turbid, and yellow in colour; after standing the pus settles at the bottom of the glass, forming a heavy, sticky deposit. If the urine is found to be acid the presence of pus is strongly indicative of the existence of suppurative pyelitis, but its alkalinity does not negative the condition. Pus may come from any part of the urinary tract. Caustic potash added to urine containing pus makes it ropy and gelatinous when the mixture is shaken. Tincture of guaiacum gives a greenish-blue colour which disappears on heating.

Microscopic examination will detect the presence of the pus corpuscles.

Hæmaturia.—The amount of blood may be so slight that there is practically no alteration in the colour of the urine, but it is usually present in sufficient quantity to render the fluid decidedly smoky or red, and may be so copious that it looks like porter and contains considerable masses of coagulated blood.

Tests.—Spectrum analysis is a certain test but is rarely used clinically. If tincture of guaiacum and turpentine are mixed and shaken well together and urine is slowly added, a deep blue colour results if blood is present; a similar colour is produced if a few drops of tincture of guaiacum are added to the urine and ozonised ether is then poured into the mixture. Microscopic examination will reveal the presence of blood corpuscles when all other tests fail.

Causes.—Blood may come from any part of the urinary tract; and in women, from the vagina or rectum as well.

Renal blood is not usually abundant, and is uniformly mixed with the urine; it sometimes occurs as casts of the renal tubules. Vesical and prostatic blood, unless the bleeding be profuse, comes away at the end of micturition, the last few drops passed being often pure blood with clots. Blood from the urethra is passed independently of micturition, although the first rush of urine may clear the passage of a little blood or clot which may lie there.

Bleeding from any part of the urinary tract may be due to injury, acute congestion and inflammation, the irritation of a foreign body such as a calculus, or to the presence of a new growth.

Hæmorrhage from the kidney may also be due to purpura or scurvy, to the presence of the Bilharzia hæmatobia, or to the incautious use of turpentine, cantharides, chlorate of potash, or other irritant poisons.

Sugar in the urine.—The presence of sugar in the urine is to be suspected if its specific gravity is high, and may be determined by boiling a small quantity of urine with about twice its bulk of fresh Fehling's solution (which has been previously boiled), when a yellowish-red precipitate will appear. If the urine contains albumen, this must be precipitated by acetic acid, and cleared by filtering before the test is applied.

Glycosuria does not necessarily imply that the patient is diabetic.

Bile in the urine.—Bilirubin and bile acids are present in the urine when there is obstruction in the biliary passages. Urine containing bile pigment has a rich orange tint, and the addition of a little nitric acid causes a play of colours due to oxidation. A drop of urine should be placed on a white porcelain dish, and a drop of acid near to it, so that they slowly mix.

Spermatozoa may be found by microscopic examination of the urine passed soon after an emission, and in cases of spermatorrhœa.

Threads of mucus, mixed with pus and epithelial scales, are often present in cases of old gonorrhœa, gleet, and chronic prostatitis.

Casts of the renal tubules may be hyaline, epithelial, or blood. Hyaline and epithelial casts are important evidence of parenchymatous inflammation of the kidneys.

DISORDERS OF MICTURITION

INCREASED FREQUENCY OF MICTURITION

The normal frequency of micturition varies in different individuals; with the amount of urine secreted, and hence with the temperature of the atmosphere; with the quantity and nature of the fluids drunk; and with the amount of fluid lost by the skin. Abnormal frequency, irrespective of that which may attend diabetes or polyuria, may occur in connection with, or independently of, retention of urine, and the causes will be discussed under these two headings. It is necessary to state here that patients who suffer from frequency of micturition speak of themselves, and are too frequently described by medical men, as suffering from "incontinence"; but genuine incontinence is a very rare condition, and whenever the term is used—especially by a patient—it should always suggest the overflow which is the outcome of prolonged retention.

FREQUENCY OF MICTURITION WITHOUT RETENTION—"INCONTINENCE"—"IRRITABILITY OF THE BLADDER"

True incontinence of urine is generally of nervous origin. It is a well-known fact that certain mental conditions (*e.g.* fright) will cause an involuntary escape of urine in consequence of temporary paralysis of the neck of the bladder. Hysterical women sometimes suffer from incontinence which, if neglected, may become a confirmed habit. The worst form of true incontinence is met with in cases of injury to or disease of the spinal cord (see p. 278, vol. ii.).

The nocturnal incontinence of children.—It sometimes happens that boys, much less often girls, below the age of puberty suffer from nocturnal incontinence, although they are perfectly well able to control the micturition centre during the day, except in bad cases. If the habit be neglected, and especially if it occurs in older children, it becomes pronounced and the incontinence may be present during the day, rendering the child's life unhappy from the personal annoyance it occasions, and the disgust felt by his companions. The cause of nocturnal incontinence is not always evident; the child is often highly nervous and excitable, and may suffer from dyspepsia. Sometimes he is deficient in intelligence, and naturally lazy in his habits. Local irritation, such as may be occasioned by a long and tight prepuce with retained smegma, or by ascarides in the rectum, may be an exciting cause. Occasionally the incontinence first makes its appearance during convalescence from some acute illness.

Treatment.—Local causes of irritation must be removed, and, if the prepuce is long and tight, circumcision should be performed. Punishment, which is too frequently inflicted on these children, is worse than useless. The bladder must be emptied when the child goes to bed, and he should be taken up again for the same purpose the last thing at night. He should sleep on a hard mattress, with no superfluous clothing. Of all drugs belladonna, which acts as a nervous sedative, and diminishes muscular contraction, is the most serviceable, and may be usefully combined with strychnine, iron, tincture of lycopodium, quinine, or capsicum. The drug should at first be given in 5 minim doses three times a day, the quantity being gradually increased until a decided effect is produced. When the habit has been stopped, the doses should be gradually diminished in quantity, and finally in frequency, until no further treatment is necessary.

In bad cases a dose of bromide of potassium given at night may be of service. If after a fair trial of these means no improvement has taken place, trial may be made of the daily passage of a bougie, or a little nitrate of silver solution (10 grs. ad ℥i.) may be thrown into the prostatic urethra by means of Guyon's injector, and this may be repeated at weekly intervals, the belladonna being continued during the treatment.

The diet must be plain and unstimulating, the bowels must be regulated, and any digestive trouble remedied. The amount of fluid drunk should be limited to what is absolutely necessary, and none should be given for some time before the child goes to bed. Cold douching over the loins and plenty of exercise in the fresh air should be enjoined.

Irritability of the bladder, causing increased frequency of micturition, is always a symptom of some pathological condition, the removal of which is followed by complete and permanent relief of this troublesome symptom. Chief among these causes may be mentioned calculi, foreign bodies and tumours of the bladder, cystitis, gonorrhœal inflammation of the deeper parts of the urethra, prostatitis, and a highly acid condition of the urine. In the early days of enlarged prostate, before there is any actual retention, there is some vesical irritation, probably dependent upon mechanical irritation at the neck of the bladder. Lastly, certain drugs, such as cantharides, may cause frequency of micturition accompanied by considerable pain. The treatment of vesical irritability is that of its cause.

FREQUENCY OF MICTURITION WITH CHRONIC RETENTION AND OVERFLOW

Causes.—Inability to completely empty the bladder may result from any of the following conditions:—

Mechanical impediment to the free flow of urine, especially when it is of such a nature that increased muscular effort is unavailing to overcome it. Under this heading we include hypertrophy or cancer of the prostate, stricture of the urethra, and the growth of a vesical tumour which blocks the outlet of the bladder. Of these conditions prostatic hypertrophy is by far the most common cause. In women, mechanical obstruction may be due to a tumour of the ovary or to an enlarged uterus, which has become impacted in the pelvis.

Diminished contractile power and muscular force of the bladder wall is usually the result, rather than the cause, of retention, for the chronic over-distension of the bladder leads to dilatation, with atrophy and atony of the muscular coat. When this is once established, it adds to the retention which caused it. A dilated bladder is also frequently sacculated, and the sacculi being devoid of muscular tissue are only partially emptied during micturition.

Atony of the bladder, with chronic retention, is sometimes found in old men as the only pathological condition present, and is favoured, if not caused, by habitual neglect to empty the bladder until the call to do so becomes imperious.

Cystitis sometimes leads to diminution of the muscular power of the bladder, owing to the infiltration of its wall by inflammatory tissue; but from this cause the effect is almost inappreciable, as it is very rare for the muscular coat of the bladder to be affected by inflammation, which is almost always confined to the mucous membrane.

Defective nervous supply.—In consequence of injury or disease of the brain, spinal cord, or nerves supplying the bladder, there may be partial or complete paralysis of the organ, which is consequently partly or wholly incapable of voiding its contents. In tabes dorsalis it sometimes happens that the bladder is early affected; indeed, this trouble may be the first to lead to the detection of the nervous lesion. The sensibility of the bladder being diminished, the patient does not experience the normal call to micturate, or at least it is infrequent and slight. He finds, moreover, that the facility of passing urine has left him, that he has to wait for some time before the flow begins, and that when it does so the stream is feeble, and may be frequently interrupted, so that the act takes a long time. In such a case there is no overflow, but a varying quantity of urine is retained, and this aggravates the condition.

Hysterical retention is rarely chronic.

Results.—It does not necessarily follow that because there is retention there must also be overflow and increased frequency of micturition, but when the cause is some mechanical impediment or nervous damage leading to almost complete paralysis this will be the case. The actual frequency varies according to the amount of urine which can be voided at each attempt; in the worst cases the urine almost perpetually dribbles away, especially during any act, such as coughing, which increases the intra-abdominal tension.

The frequent call to micturate is not only a serious source of inconvenience and annoyance to the patient, but since it interferes with his sleep very soon impairs the general health to a marked degree. The retained urine, moreover, may putrefy and excite cystitis with possible spread of the inflammation to the ureters and kidneys (see p. 507).

Diagnosis.—The fact of retention is easily proved by directing the patient to empty his bladder, and immediately after he has, as he thinks, done so, by passing a catheter and drawing off the amount of urine left (Residual Urine, see p. 567).

When the retained urine is small in quantity abdominal examination will not reveal any distension of the bladder, but in bad cases the viscus may be found considerably above the pubes. The diagnosis of the cause must be determined by the general symptoms complained of.

Treatment.—The treatment consists in removal of the cause when possible, and failing this, in periodically emptying the bladder by means of the catheter, and in the prevention of cystitis.

ACUTE TEMPORARY RETENTION OF URINE

Causes.—Temporary and complete retention of urine may be due to congestion or inflammation of the urethra or prostate, especially in cases of stricture of the former or enlargement of the latter. It may also be due to gonorrhœa, to perineal abscess, to the impaction of a stone or foreign body in the urethra, to ligatures round the penis, or to the obstruction caused by paraphimosis or acute inflammation of a very tight prepuce. In women acute retention may complicate labour, or may be caused by the sudden impaction of an ovarian or uterine tumour in the pelvis.

The influence of the nervous system is shown in the retention which sometimes follows injuries of or operations on the rectum, or adjacent parts, or which occurs in hysterical women.

In cases of spinal injury retention of urine, although acute in its onset, is chronic in its course.

Signs and effects.—The diagnosis of acute retention is usually sufficiently obvious. The patient suffers intensely, is restless and anxious, and palpation in the supra-pubic region reveals a rounded fluid swelling, which is very tender.

If the retention is unrelieved the membranous urethra will give way and extravasation will ensue, provided the obstruction is anterior to this point. Rupture of the bladder from mere retention does not occur unless the patient receives some injury or sudden jar (see vol. ii. p. 348), for sooner or later the distension of the bladder reaches such a degree that the backward pressure of the column of urine arrests further secretion. The effect of acute retention upon healthy kidneys is inappreciable, but if they are diseased a fatal result may ensue.

Treatment.—The treatment of acute retention consists in the removal of its cause or when, as in spinal injury or reflex retention after an operation on the rectum, this is impossible in the employment of the catheter so long and as often as may be necessary.

The method of procedure in cases of stricture, enlarged prostate, etc., is described under these conditions, and it is only necessary here to mention those measures which may be necessary to afford immediate relief when a catheter cannot be passed or the cause removed.

Supra-pubic aspiration may be repeated three or four times if the means adopted for the removal of the cause of the retention do not prove successful. The operation is easily and safely performed by thrusting a clean needle in the middle line immediately above the pubes into the bladder where it is uncovered by peritoneum; as the needle is withdrawn the vacuum must be maintained so that the urine in the needle is prevented from escaping into the cellular tissue.

Supra-pubic drainage becomes necessary if the obstruction cannot be overcome within a reasonable time, and especially if there is acute cystitis, and the patient's general condition is serious. The bladder is exposed by an incision about a half or three-quarters of an inch long, placed in the middle line just above the pubes; a trocar is thrust into the viscus and may be retained in position or be replaced by a soft rubber catheter, which can easily be introduced through the canula. If there is bad cystitis, drainage and irrigation may be usefully combined.

Perineal puncture and drainage is preferred by some to the supra-pubic operation. The fore-finger placed in the rectum fixes the prostate and draws it towards the perineum, through which the trocar is thrust directly into the bladder; a soft catheter is then introduced through the canula and tied in. **Perineal cystotomy** may also be performed and has the advantage, not only of providing free drainage, but of permitting digital exploration of the bladder.

Puncture of the bladder through the rectum has been rightly abandoned.

PAINFUL MICTURITION

Pain of varying intensity may precede, accompany, or follow the act of micturition, and may be felt at the end of the urethra, at the neck of the bladder, or in the supra-pubic or perineal regions. Sometimes the call to micturate is imperative and accompanied by severe suffering of a spasmodic character, quickly relieved, however, when the bladder is emptied (*strangury*).

Etiology.—The cause of painful micturition may be situated in any part of the urinary tract.

The prepuce.—A very tight foreskin, balanitis, and sores about the end of the penis may occasion considerable smarting pain as the urine escapes, but it quickly passes off.

The urethra.—In women vascular caruncle causes pain which may be agonising and persist for some time after micturition. Mechanical obstruction by stricture, the impaction of a calculus, etc., may cause slight local pain during the passage of the urine. Gonorrhœa, especially when the deeper parts of the urethra are affected, and during the acute stage, causes severe smarting pain during the passage of the urine over the inflamed mucous membrane; if the prostate and prostatic urethra are involved the pain persists at the end of micturition and is often very severe.

The prostate.—In prostatis and acute congestion of the gland there is considerable pain at the end of the penis after micturition, but it usually soon subsides.

Simple enlargement and cancer of the prostate are often attended by a painful and urgent desire to empty the bladder; the pain precedes and accompanies the act but gradually subsides as the bladder is emptied.

The bladder.—Cystitis, especially the acute form, is accompanied by severe strangury and pain preceding the act of micturition, but as the urine flows, the inflamed mucous membrane being no longer irritated, the pain ceases, to return, however, at frequent intervals.

A foreign body or stone in the bladder causes more or less pain at the end of micturition, when it is forced by the contraction of the organ against the very sensitive mucous membrane at the neck.

Tumours of the bladder do not usually occasion painful micturition unless there is cystitis.

The kidney.—Calculous disease, inflammation, and new growths of the kidney sometimes cause considerable strangury and pain at the end of the penis, very often, however, the act of micturition is quite painless.

Changes in the urine.—Certain drugs, notably cantharides and turpentine, may produce severe strangury. Highly concentrated urine, marked acidity, and the presence of uric acid, oxalates, and other salts in excess may lead to considerable smarting pain as the urine passes along the urethra.

Treatment.—The treatment of painful micturition is that of the condition inducing it. When the symptom itself is so severe that it demands individual attention, much relief may be obtained by the employment of the hot hip-bath, hot fomentations to the pubic and perineal regions, and the use of belladonna and morphia suppositories. Internally the citrate of potash, lithia, tincture of hyoscyamus and belladonna are very useful, especially when the pain is due to an excess of uric acid in the urine. Cannabis indica is sometimes very serviceable in cases of strangury and "spasm" from cystitis or prostatic mischief.

THE PATHOLOGICAL EFFECTS OF CHRONIC OBSTRUCTION TO THE FLOW OF URINE

The various effects which chronic urinary obstruction may entail on the parts behind the seat of the obstruction will be generally indicated here, but for an account of the symptoms connected with the individual changes the reader is referred to those chapters dealing especially with diseases of the urethra, prostate, bladder, and kidneys. It will be convenient to describe the changes which might ensue in a case of stricture of the urethra, but it must be remembered that although in all cases of obstruction the effects will be the same in nature, their extent and the parts affected will necessarily vary with the degree and position of such obstruction.

Some of these effects, *e.g.* dilatation of the bladder or ureters, are the result of simple mechanical pressure; others, *e.g.* hypertrophy of muscular tissue, are dependent upon the power of living tissue to adapt itself, within certain limits, to the calls made upon its resources, while a third class of effects (inflammatory) is caused by the natural reaction and resistance of the tissues in the presence of mechanical irritation or the attack of micro-organisms.

The urethra.—In a case of urethral stricture the passage behind the seat of obstruction becomes dilated by the pressure of the urine (Fig. 173, p. 584); the lacunæ are more prominent, and in consequence of prolonged over-stretching the urethral wall loses some of its normal elasticity. Owing to chronic inflammation the mucous membrane is frequently greyish-white in colour, pigmented, and perhaps superficially eroded, and occasionally coated with phosphates if the urine has been for a long time decomposed and rendered alkaline. The occurrence of peri-urethral abscess in connection with the urethra behind a stricture is described on p. 590, and rupture of the urethra on p. 344, vol. ii.

The bladder.—Obstruction to the escape of urine from the bladder is met by compensatory hypertrophy of its muscular wall. Provided this be efficient no further change takes place, but if hypertrophy fails in its object the bladder wall yields to the increased pressure, and dilatation with, perhaps, the formation of sacculi results. Hypertrophy of the bladder is further favoured if chronic cystitis exists, since the thick ropy muco-pus is passed with trouble, and hence the difficulty is increased. Chronic inflammation will cause thickening and pigmentation of the mucous membrane, and here and there patches of erosion may be present, especially over the prominent ridges caused by the hypertrophy of the muscular bundles. The mucous membrane may be covered with a fibrinous and mucous layer rich in phosphates, and phosphatic concretions are by no means uncommon.

The ureter and pelvis of the kidney.—If the obstruction be situated in the urethra, both ureters and kidneys will be equally affected mechanically, but provided it only implicates one ureter the changes are correspondingly limited; inflammatory changes may, however, affect both sides as in the case of a growth affecting the vesical orifice of one ureter and exciting general cystitis, in such the affected ureter, the kidney, and its pelvis will show evidence of pressure, but both may be equally inflamed.

The pressure effects—hypertrophy and dilatation of the ureter and hydro-nephrosis—are due to the fact that as the ureter traverses the bladder wall obliquely for about three-quarters of an inch, hypertrophy of the muscular tissue of this organ leads to compression and obstruction of this portion. The degree of these changes varies within the widest limits. When cystitis has been set up the micro-organisms may pass up the ureter and excite pyelitis and nephritis.

The kidneys.—Dilatation of the pelvis is quickly followed by absorption of the secreting substance of the kidney, which may almost completely disappear (*Hydronephrosis*, p. 515).

Chronic interstitial nephritis is a usual consequence of obstructive disease of long duration, and proves a very formidable danger, for at any time fresh irritation may culminate in acute mischief, and too frequently excites suppurative nephritis with suppression of urine and uræmia as probable consequences (*Surgical Kidney*, p. 518).

While the above is an account of the changes which may occur, it must be remembered that the degree to which such pathological states may go, and the danger which they occasion varies within the widest limits. The object of the surgeon must necessarily be to prevent any such changes by timely removal of the obstructing cause by means suitable to its nature.

URINARY FEVER—URETHRAL SHOCK ("URETHRAL OR CATHETER FEVER")

The name urinary fever is applied to the assemblage of symptoms which may occur as the result of mechanical irritation of the urethra, but as will presently be shown, the term has a wide significance and includes various conditions differing considerably in their mode of onset, course, and severity.

Causes.—Urinary fever may be excited by the passage of instruments, or of a calculus, or by the impaction of a foreign body; it is much more likely to occur if the disease necessitating instrumentation is in the membrano-prostatic urethra. Some people seem especially liable to be affected, and in its most severe forms the condition will be found to be associated with renal mischief. There is no doubt that in the majority of cases it is not so much the mere passage of the instrument, as the fact that by so doing a small breach of surface is made, the importance of which will be presently referred to. Decomposition of the urine is a favouring condition.

Pathology.—Excluding cases of undoubted septic infection from the use of dirty instruments, and considering only those conditions to which the term urinary fever can properly be applied, there are two views held as to the means by which the symptoms are induced by mechanical irritation, and it seems highly probable that each may play a part in the pathological process. According to the **neurotic theory**, it is supposed that in consequence of mechanical irritation the excitation of the sympathetic and cerebro-spinal nerves of the urethra is followed by reflex congestion of the kidneys, which may, under favouring conditions, culminate in actual inflammation, the severity of which would in some measure at least depend upon the previous state of the renal tissue, and the general condition of the patient. The condition of shock which catheterism sometimes causes is similarly attributable to reflex engorgement of the abdominal viscera, and may be regarded as an exaggeration of the slight shiver which sometimes occurs in healthy men at the end of normal micturition. While, however, the possible influence of the nervous system cannot be ignored, it is pretty evident that the acute febrile disturbance which may follow catheterism has its origin in **septic absorption** through a lesion—it may be a very small one—of the urethral mucous membrane. It is noticeable that when acute urinary fever occurs the symptoms are deferred until after the first act of micturition, *i.e.* until after the septic products contained in the urine have been brought in contact with the damaged surface; and that if the urine be healthy the risk of urinary fever is very slight. It is further important to note that urinary fever is very rare after internal urethrotomy or perineal section, doubtless because these operations afford free drainage, and hence septic absorption is not so likely to occur. Again, it is to be observed that in cases of recurrent urinary fever successive attacks can hardly be due to nervous influence, since no further instrumentation has in many cases been resorted to, and it is far more probable that they are due to further absorption of poison, and are to be regarded as successive attacks of acute septic poisoning.

Morbid anatomy.—It has occasionally happened that death from shock has speedily followed on the passage of an instrument, and the kidneys have been found intensely congested, but otherwise healthy. In cases of persistent fever the kidneys will always be found to be the seat of chronic interstitial nephritis, and in some instances this has been suddenly wakened into more acute mischief by the congestion due to irritation or septic absorption, and points of suppuration may be present (*Surgical Kidney*, p. 518).

Symptoms.—As already stated, the effects which instrumentation may occasion vary considerably, so that certain varieties of so-called urinary fever are to be recognised, each of which will be specially dealt with.

Urethral shock.—It occasionally happens that the gentlest manipulation of an instrument causes the patient to break into a profuse sweat and to feel faint, or actually become unconscious, and in rare cases a convulsion occurs. As a rule recovery is rapid, and if he be questioned on the point the patient will frequently say that he felt no pain, and cannot explain why "he has been so silly." In very rare cases death has been known to result in consequence of congestion of the kidneys and urinary suppression.

Urethral shock requires no treatment other than that employed in an ordinary fainting attack.

Acute transient urinary fever—Acute urinary sepsis.—At the time of passing the instrument a drop of blood has usually been drawn, indicating a small breach of surface. Nothing occurs until the patient micturates, but soon after this he has a more or less pronounced rigor, the temperature rises to 104° or 105° F., or even higher, there is headache, nausea, and perhaps vomiting and diarrhœa, with pain across the loins. The quantity of urine is often diminished, and it may be bloody. Usually within thirty-six hours all these symptoms disappear and the patient is as well as he was before. He may or may not have another attack if instrumentation is again resorted to; and sometimes recurrent attacks occur at intervals of two or three days without any fresh urethral irritation (*Recurrent Urinary Sepsis*).

Treatment.—There is little doubt that this form of urinary fever is due to the absorption of septic material through an abrasion or small wound of the urethral mucous membrane, and hence it is necessary that instrumentation should be conducted in all cases with the very greatest care, so that no wound may be inflicted, that the instrument should be absolutely clean, and that it should be passed when possible under the most favourable conditions as regards the state of the urine and the general condition of the patient. During the attack the patient must be kept warm, and hot drinks should be freely given during the cold stage, but as sweating comes on and the temperature drops, recovery will soon occur. The bowels must be freely acted on by enemata or croton oil, and the action of the kidneys should be encouraged by diuretic and diluent drinks.

Quinine and opium are of doubtful value, except perhaps in malarial subjects. The question of future catheterism must be determined on the merits of the case, in some it is imperative, in others, *e.g.* stricture, internal urethrotomy, or some other measure suitable to the case, should be substituted (see p. 588). The urine must as far as possible be rendered harmless by washing out the bladder and treating the cystitis.

Chronic or persistent urinary fever is especially met with in old men whose kidneys are diseased, who require catheterism owing to enlargement of the prostate, and whose urine is frequently loaded with septic material. The onset of the symptoms is insidious; there is general loss of health, strength, and appetite, the temperature is slightly raised at night, but high fever is, as a rule, absent. The amount of urine may or may not be diminished. Temporary improvement may be followed by relapse; the general symptoms become more grave, the tongue is dry and furred, the skin is harsh, the complexion sallow, there is languor and drowsiness, accompanied by low muttering delirium, deepened into coma which terminates in death. The fatal result may occur in two or three weeks or be postponed for months. In some cases recovery occurs.

Treatment.—When it becomes necessary for the patient to resort to habitual catheterism the precautions advised on p. 569 must be adopted. If this form of urinary fever sets in, every endeavour must be made to promote the action of the bowels and kidneys to support the general health and to reduce the urethral irritation to a minimum. Warmth and rest are essential (see Pyelo-nephritis, p. 518).

CHAPTER XXIII

SURGICAL DISEASES OF THE KIDNEY

Anatomy.—The kidneys are composed of cortical and medullary secreting substance consisting of tubules lined by epithelium which varies in character in different parts of their length. The organs are covered with a fibrous capsule and lie amid a considerable quantity of cellular tissue and fat which keeps them in position.

They are obliquely placed one on each side of the spinal column about opposite the last dorsal and upper two or three lumbar vertebræ, the right being rather lower than the left. The peritoneum covers the kidneys in front except where the descending colon comes in contact with the left, and the ascending colon and duodenum with the right. Very rarely there is a complete meso-nephron, and the kidney is freely movable. Posteriorly the kidneys lie against the eleventh and twelfth ribs, the psoas and quadratus lumborum muscles with the anterior layer of the lumbar fascia. The supra-renal capsules lie above and a little in front of the upper ends. The liver is above and in front of the right kidney, and the spleen is in front of the outer border of the left. The renal vein, artery, and ureter occupy the hilum of the kidney in this relative position from before back.

The ureter is expanded into the pelvis at the hilum and is subdivided into calices which embrace the apices of the medullary pyramids. The tube passes down behind the peritoneum (to which it is fairly closely attached) to the brim of the pelvis, which it crosses about where the common iliac artery divides; it is here crossed by the bowel and higher up by the spermatic vessels. Reaching the pelvis the ureter (in the male) enters the posterior peritoneal ligament of the bladder and runs along the side of this viscus to its base, being crossed low down by the vas deferens which passes to its inner side. In the female the ureter runs in the base of the broad ligament near the junction of the cervix with the body of the uterus, and thus reaches the bladder.

The vesical portion of the ureter is considerably narrowed, and runs obliquely through the muscular wall of the bladder for about three-quarters of an inch. The ureter is lined by mucous membrane covered with a peculiar stratified epithelium, the superficial cells of which are more or less cubical, the deeper ones pear-shaped.

MOVABLE AND FLOATING KIDNEY

Under normal conditions the kidney, embedded in a layer of fat, occupies a fixed position, but in some cases it is capable of a varying amount of movement. If the peritoneal relations of the organ are normal, the condition is spoken of as *movable* kidney; but if there is a complete meso-nephron, the kidney is said to be *floating*. The former is an acquired, the latter a congenital condition, and although clinically they cannot always be distinguished, the peritoneal relation would be discovered and must be reckoned with in any operation which might be undertaken to remedy the condition or any disease which may be present in such a kidney.

Causes.—Floating kidney (the usual clinical term for both conditions) is much more common in women than men and is usually met with on the right side, probably on account of the presence of the liver. Repeated pregnancies and rapid emaciation may induce the condition, since they both tend to diminish the abdominal support and the latter causes atrophy of the surrounding fat. Tight-lacing and injuries to the loin are cited as causes. An enlarged and diseased kidney may, owing to its weight, tend to become movable.

Symptoms.—The slighter forms of mobility cause no symptoms, but if the excursion is free more or less severe signs may be present. The patient complains of a sense of weight and dragging in the loin and abdomen, which is aggravated on movement. There is some pain, which is often paroxysmal and may be very severe. Vomiting and dyspeptic symptoms are not uncommon, and there may be frequency of micturition. The urine is normal, provided the kidney be not diseased, but occasionally there may be a little albumen, or even blood, probably due to temporary congestion of the organ from partial twisting of its pedicle. Temporary hydronephrosis has been induced by twisting of the ureter. The patient may herself be quite conscious of the presence of a movable tumour in the abdomen, and on palpation the kidney will be found to slip away from between the hands placed one behind and one in front of its normal position in the loin. It may be pushed towards the pelvis or the middle line, and its characteristic shape may be plainly felt. On pressure, pain and nausea are often complained of. A floating kidney is sometimes enlarged from chronic congestion. As the organ lies in the loin, respiratory movements may be distinctly conveyed to it by the liver or spleen. If the kidney is not in the loin this region may be found to be somewhat flattened and distinctly resonant on percussion.

The annoyance caused by the condition varies within the widest limits. The symptoms are liable to exacerbation during the menstrual period, or after exertion, and are usually in some degree proportional to the neurotic tendencies of the patient. Partial twisting of the pedicle may give rise to acute attacks of pain.

Treatment.—If the mobility causes inconvenience, an abdominal belt and pad designed to keep the kidney in its place may be tried, but the result is usually disappointing, and in some cases the pressure of the pad cannot be borne. If this be so, and the symptoms are sufficiently severe to warrant operation, nephrorrhaphy should be performed, the precaution being taken of examining the exposed kidney for stone, especially if the pain has been severe and blood has been found in the urine. The operation is described on p. 531.

THE DIAGNOSIS OF A RENAL ENLARGEMENT

Clinically any enlargement of the kidney is spoken of as a renal "tumour." The renal origin of an abdominal tumour may be diagnosed if the following conditions are present:—

It is situated in the lumbar region and tends to grow forwards towards the abdominal cavity, and, if large, to cause some flattening or even bulging of the flank, but it does not produce a swelling bulging backwards. The abdominal tumour may be made more prominent by pressure from behind (bi-manual palpation), but the hand cannot define the posterior border of the mass, which seems to be continuous with the spine, towards which it extends, nor is there any resonance posteriorly. The enlargement is rounded and has no sharp edge or notch in its anterior border. Its long axis lies from above down, and not transversely. The colon lies in front, and hence a band of resonance may be present, passing vertically downwards over the enlargement, or the bowel may be distinctly felt by palpation.

There is often decided mobility on respiration, as the organ is pushed down by the liver or spleen according to the side. Except in very thin people the normal kidney cannot be felt, and hence if it can be made out it is good evidence of its enlargement.

An examination of the urine usually affords strong corroborative evidence of the diagnosis of renal tumour by revealing the presence of pus, blood, or other abnormal ingredients; but it is important to remember that this fluid may be quite healthy, as in cases of hydro-nephrosis with complete blocking of the ureter, or large cysts growing in connection with the healthy kidney. Finally, the history of the case will necessarily assist in forming a correct diagnosis.

HYDRO-NEPHROSIS—PYO-NEPHROSIS

Hydro-nephrosis is to be regarded as a retention cyst formed by dilatation of the pelvis of the kidney and its calyces, with more or less pressure atrophy of the kidney due to chronic obstruction to the free passage of urine. When this is associated with suppurative pyelitis the resulting tumour contains putrid urine and pus, and the condition is known as pyo-nephrosis.

Causes.—Acquired hydro-nephrosis and pyo-nephrosis may be due to any form of obstructive disease situated in the urinary tract; most usually a calculus in the pelvis of the kidney or in the ureter is the cause.

Hydro-nephrosis is more common in women than men, owing to their greater liability to stone and to the frequency of disease of the pelvic organs which may entail pressure on the ureter from without. While this statement, however, is true from a clinical standpoint it is not so in reality, since in cases of neglected stricture or enlarged prostate slight degrees of hydro-nephrosis are very common.

Temporary slight degrees of this condition may follow injury to the kidney from obstruction produced by a blood clot in the ureter, or from partial occlusion due to twisting of the ureter of a movable kidney.

The occurrence of pyelitis, and hence of pyo-nephrosis, may be due to mechanical irritation by a stone, to tubercular disease, or to the spread of inflammation from the bladder.

Congenital hydro-nephrosis is sometimes met with, and is due to twisting or occlusion of the ureter, to narrowing of the urethra, or to its being imperforate. Such a condition is not, however, certain to occur in early life, provided there be some, though inefficient, means of escape for the urine.

Morbid anatomy.—The degree of distension depends upon the duration and completeness of the obstruction. In the great majority of cases it is quite inefficient to produce any clinical symptoms, although the surgeon infers its presence from the circumstance of continued obstruction.

Whether the affection be unilateral or bilateral depends upon the position of the obstruction. In cases of stricture, enlargement of the prostate, or disease of the bladder, both kidneys will be affected. If, however, a tumour of the bladder implicates the orifice of one ureter that kidney only will suffer. The pelvis and calyces of the kidney are at first merely dilated and the renal substance is practically unaltered, although the apices of the pyramids may be flattened. In the course of time the medullary substance becomes absorbed, and in advanced cases the sclerosed cortical substance shares a like fate, only patches of it remaining beneath the thickened and much dilated capsule. Ultimately the whole organ is represented by a large, loculated, dense walled cyst traversed by thickened septa but retaining more or less the general reniform shape (Fig. 161). If the case is one of simple hydro-nephrosis the interior of the cyst may be quite smooth and polished, but in the majority of advanced cases pyelitis has ensued and suppurative inflammation is present. A hydro-nephrosis may assume enormous proportions and almost fill the abdomen. The fluid contents vary according to circumstances. It may be ordinary urine but of low specific gravity and with diminished urea and salts, or it may be urine and muco-pus, which is sometimes, especially in calculous cases, very offensive and loaded with phosphates. In the more chronic cases of hydro-nephrosis the fluid is little more than water and sodium chloride.

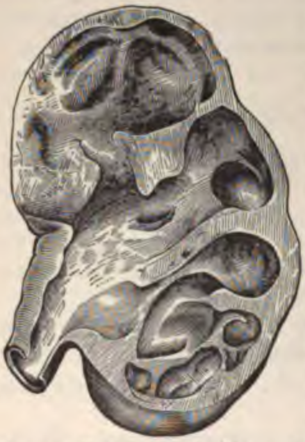
FIG. 161.—Hydro-nephrosis with atrophy of the renal substance (Follin).

Signs. — Hydro-nephrosis only causes symptoms when the tumour attains a considerable size, although of course the condition causing the obstruction may attract attention. At first the tumour may increase pretty rapidly in size, but as the secreting substance becomes absorbed, and hence the quantity of fluid poured out is diminished, the increase is less rapid, and ultimately may come to a standstill. The renal tumour may be distinctly fluctuating, or may only convey a feeling of elasticity. Pain varies much; sometimes there is nothing but a heavy dragging or dull aching, at others the pain is very severe. If the tumour is very large, vomiting and dyspeptic symptoms are likely to occur and constipation from pressure on the colon is common. The quantity of urine passed is diminished, and it may be unhealthy, according to the cause of the obstruction.

It often happens that the size of a hydro-nephrosis varies from time to time owing to a partial yielding of the obstruction; when this occurs the pain is lessened and the quantity of urine passed is quickly increased, as the tumour diminishes in size.

In cases of pyo-nephrosis the symptoms are practically those of calculous pyelitis, with which is often associated hectic fever and its accompanying constitutional disturbance. Pyo-nephrosis may open on the loin, into one of the hollow viscera, into the lung, or the peritoneal cavity.

Treatment.—The removal of the cause is plainly indicated, but by no means always possible. If it can be done the hydronephrosis will soon pass away. The cyst may be dealt with by aspiration or by incision and drainage. Aspiration is only of permanent service if the obstruction is of a temporary nature (*e.g.* twisted ureter), and consequently its application is very limited. The needle should be thrust into the tumour midway between the last rib and the iliac crest about opposite the point of junction of the anterior fourth with the second fourth of the iliac crest, unless the circumstances of the case indicate some other spot as being more suitable.

Nephrotomy is the usual treatment; it affords effectual drainage, and hence relief, and, moreover, is usually necessary for the removal of the cause.

The operation of nephrotomy is described on p. 532.

If the cause of the obstruction cannot be removed a permanent urinary fistula will result. This may not occasion any great inconvenience, but should it do so the kidney must be removed.

PERI-NEPHRITIC ABSCESS

Causes.—Suppuration round the kidney may be due to injury or disease of the organ. It is not uncommon in association with tubercular or calculous pyelitis and malignant disease. Injury of the ureter with urinary extravasation, and operations on the kidney may also excite suppuration.

Peri-nephritic suppuration may also be due to the gradual burrowing of an abscess which has its origin in some distant part, *e.g.* peri-typhilitis or pelvic mischief.

Symptoms.—The advent of suppuration will in most cases be preceded by definite symptoms produced by the condition causing it. Before suppuration has actually occurred the signs may be very equivocal. If the process is acute there will be the usual constitutional symptoms of acute suppuration with rise of temperature. The presence of the pus causes throbbing pain which is often very severe and radiates along the branches of the lumbar plexus as in renal colic. Examination will show fulness and swelling in the lumbar region, and as the abscess increases in size a distinct fluctuating tumour results.

If the peri-renal inflammation is dependent on disease of the organ there will be characteristic changes in the urine, but if it is of primary origin this fluid will be normal. A peri-renal abscess tends to burrow widely and may eventually burst into the peritoneal cavity, the ureter, one of the hollow viscera, into the chest, or externally; sometimes it burrows into the iliac region or the pelvis.

Treatment.—Before the presence of pus is certain the patient should be kept at complete rest; hot fomentations must be applied to the loin, and the bowels acted on by saline aperients in the hope of averting suppuration. When once pus has formed, no time should be lost in laying open the abscess by a transverse incision in the loin. The pus will usually be found behind the kidney, which should be carefully examined with the view of discovering the cause of the mischief and of removing this if possible. A full-sized drainage-tube is to be inserted and kept in until the discharge has practically ceased. In cases where the abscess has originated at a distance (*e.g.* appendicitis) the position of the incision will vary accordingly and the treatment appropriate to the cause must be adopted.

PYELO-NEPHRITIS—"SURGICAL KIDNEY"

Causes.—Inflammation of the pelvis and interstitial connective tissue of the kidney may be due to a local irritant, such as a calculus, or it may arise by extension upwards from the lower urinary tract in cases of urinary obstruction from whatever cause arising. It may also be consecutive to spinal injury or disease. In surgical practice these inflammatory conditions are usually slowly induced, but when once the kidney is the seat of interstitial nephritis, the inflammation may be given a sudden impetus by the invasion of micro-organisms along the ureter and terminate in diffuse suppuration and death in a few days (see Urinary Fever, p. 508).

Cases of pyelo-nephritis also arise in connection with the acute fevers and any general infective process, but such more usually come under the care of the physician.

Morbid anatomy.—Chronic interstitial nephritis and pyelitis are characterised by dilatation of the renal pelvis with enlargement of the kidney. The renal substance is cirrhotic owing to an increase in the amount of the intertubular connective tissue. As the dilatation of the pelvis proceeds the pyramids become gradually absorbed, and ultimately a thin layer of cirrhotic cortex may alone represent the secreting substance. If the cause inducing these changes be removed they cease and the gradual contraction of the newly-formed scar tissue leads to a diminution in the size of the diseased organ (*cicatricial kidney*).

At any time a septic element may be introduced into the case and acute nephritis with numerous small areas of suppuration will result. The septic organisms find their way up the ureter from the bladder. It is by this means that obstructive urinary trouble so frequently proves fatal in the absence of skilled treatment. The kidney is enlarged, soft, friable, and deeply congested; the surface of section is spotted and streaked with pale areas of suppuration, and suppurative pyelitis is present. The inflammation extends to the capsule and peri-nephritic fat which may also be the seat of suppuration.

Symptoms.—The symptoms vary much in severity according to the actual degree and acuteness of the mischief.

In chronic cases the renal affection should be suspected if the urine is increased in amount, is of low specific gravity, and contains but little albumen. The patient often complains of slight aching across the loins and his general health is impaired.

When subacute or acute interstitial nephritis is present, but without suppuration, the urine may present the same changes. The impairment of the health is more marked; the complexion becomes sallow, the appetite fails, and languor, headache, and drowsiness are often experienced. Sometimes there is a night rise of temperature and all the signs may be much aggravated by instrumentation of the urethra. These symptoms may last for a long time, and then the patient slowly improves with the subsidence of the process, or acute inflammation may supervene. This will be marked by a rigor, which is frequently repeated, and a rise of temperature of from 4° to 6° F. The fever may remain continuously high or may be intermittent. There is pain across the loins, and the urine, maintaining its usual amount until just before death, is loaded with pus and often very offensive. Health and strength rapidly fail; there is marked pallor, emaciation, rapid pulse, dry tongue, and profuse sweats. The bowels are irregular, sometimes constipated, at others relaxed. As the end approaches the complexion often assumes a greyish tint, the languor and drowsiness increase and deepen into coma a few hours before death. A fatal termination is almost inevitable; it may occur within two or three days or be postponed for as many weeks. Recovery is extremely rare.

Treatment.—These serious affections would not occur provided proper treatment was adopted sufficiently early in all cases of obstructive disease, and hence preventive treatment lies in this. The curative measures are described under Urinary Fever, p. 510.

TUBERCULAR KIDNEY

Tubercle of the kidney may occur from the upward extension of tubercle of the lower urinary tract, as part of general tuberculosis, or it may originate as a primary condition affecting either the renal substance or the pelvis of the organ. The disease is rather more common in males than females and usually occurs in youth or early adult life.

Morbid anatomy.—Tubercle commonly implicates both kidneys but not in equal degree. When it begins in the renal substance the bases of the pyramids and the adjacent cortex are usually first affected, and as the nodules break down and coalesce the area of disease becomes extensive and the softened patches discharge into the pelvis and excite pyelitis. The kidney is enlarged and, eventually, may become converted into a large pyonephrosis containing curdy pus with cheesy material which may more or less block the ureter. The capsule of the organ is considerably thickened, and the inflammation tends to spread to the peri-renal fat; peri-nephritic suppuration sometimes occurs.

Symptoms.—When the disease is sufficiently advanced to cause symptoms, they are very similar to those occasioned by calculous pyelitis, and there may be additional evidence of tubercular disease of other parts. It is important to note that in cases of renal tuberculosis the symptoms are often referred to the bladder with such constancy and persistence that disease of this viscus may be diagnosed. The pain in tuberculosis may or may not be severe, and definite attacks of colic may be excited by the passage of cheesy masses along the ureter. The urine contains pus and curdy material; the pyuria is constant and is not liable to those complete intermissions which are so important a diagnostic feature of calculous pyelitis. Hæmaturia is either absent or trivial in amount. After centrifugalisation of the urine the tubercle bacillus may sometimes be detected and, in cases of doubt, inoculation of a guinea-pig with some of the purulent material will be followed by tubercular infection. As the disease advances a renal tumour will be present; the patient fails in general health and hectic fever sets in as in tuberculous disease elsewhere. The quantity of urine and of urea is diminished proportionately to the amount of disease, and if both kidneys are extensively affected uræmic poisoning may terminate the case.

Tubercular kidney is a most serious and usually fatal disease, for it is rarely limited to one kidney, and consequently complete eradication of the mischief by nephrectomy can seldom be performed.

Treatment.—The general treatment for tubercular disease must be enforced. When pyo-nephrosis is present, relief may be afforded by nephrotomy and drainage, but this should not usually be done if the patient is rapidly losing strength and obviously dying of widespread tubercular mischief.

Nephrectomy is rarely possible in view of the involvement of both kidneys and possibly the presence of tubercle elsewhere.

CALCULUS IN THE KIDNEY

Causes.—Our knowledge of the fundamental causes which induce the formation of stones in the kidney is at present imperfect, although we may safely assert that they are dependent in the main upon some digestive deficiency and changes in the renal epithelium. That digestive trouble is at the bottom of the mischief seems clear when we regard that process as a series of chemical changes which not only convert the food-elements into substances capable of ready absorption for the use of the tissues, but which also provide for the elimination of waste products in a form suitable to the economy.

We know, moreover, that calculus is especially common in those of a gouty disposition and in overfed and dyspeptic children. Deficient digestion prevents the due oxidation of uric acid into urea and, furthermore, increases the amount of salts present in the urine. In addition, however, it must be admitted that there is also some fault in the renal epithelium, leading to a deficiency of the power of elimination; it is highly probable that the foundation of the calculus is laid within the renal epithelial cells (especially those of the straight tubules), and that it is only when a certain size is attained that the stone escapes into the pelvis of the kidney, either to pass out of the body with the flow of urine, or to remain in some part of the urinary tract as a foreign body and source of irritation.

As regards general etiology it may be mentioned that stone is much more common in men than women, and in the young and old; but it is noticeable that the social conditions of life present a striking contrast in the case of the young and old, for whereas stone in children is almost confined to the poor, in adults it is essentially the privilege of the well-to-do. Cadge thinks that stone in poor children is due to the absence of milk in the diet. In some cases, no doubt, the conditions favouring the formation of calculi are hereditary.

It is well known that stone is very common in India and in certain other geographical areas; this proclivity is attributed to the nature of the drinking-water.

Varieties and effects.—Most renal stones are formed of uric acid, many of oxalate of lime, and a few of other salts (see p. 548); if the stone has excited pyelitis, phosphates will be deposited on its surface and in its crust. Renal calculi are usually solitary and confined to one kidney, chiefly the left, but sometimes they are very numerous and may be bilateral. In shape, size, and general appearance there is much diversity; if the stone is large it may form a more or less complete cast of the pelvis and calyces, in which it lies. A small stone may pass along the ureter to the bladder and escape by the urethra, or it may be arrested in any part of the urinary tract. If the stone remains in the substance of the kidney or within a calyx, or the pelvis of the kidney, the effects it will produce depend upon a variety of causes; upon its size and shape, the roughness or otherwise of its surface and, especially, upon its mobility. In some cases stones are found *post-mortem* firmly embedded in a more or less healthy kidney, or enclosed in a dense fibrous envelope formed of the thickened capsule with little or no renal substance left; in such the patient may never have complained of any symptoms. In the vast majority of cases, however, the chronic irritation excites pyelitis and suppuration, and if the stone causes obstruction to the free escape of urine, pyo-nephrosis will result.

A pyo-nephrosis may attain a very large size as stated on p. 516, and may burst in various directions; occasionally a stone has been thus discharged through the loin and cure has resulted, and it is surprising that surgeons should so long have been deterred from the operation of nephro-lithotomy thus clearly indicated by Nature herself. Although in some few cases the kidney substance is practically healthy this will, as soon as pyelitis is set up, be the seat of chronic nephritis, by no means the least serious effect of calculous disease.

Clinical history.—As already stated, renal calculus does not necessarily cause symptoms, although such a happy event is very rare. The symptoms vary much in severity and are sometimes so equivocal that the real nature of the case is overlooked, or stone may be diagnosed when none is present. A history of renal colic, coupled with other signs, is of suggestive import.

Renal colic is the term applied to the chain of symptoms caused by the passage or attempted passage of a stone, blood clot, mass of cheesy material, or other foreign substance along the ureter. The onset and subsidence of these symptoms is sudden; the attack may last for an hour or for three or four days, but when thus prolonged there are remissions in the symptoms. The patient is seized with intense pain, which is distinctly paroxysmal; during the intervals he is comfortable. The pain shoots from the loin towards the umbilicus down to the penis and testicle (which is retracted) and often to the inner part of the thigh—rarely it extends to the leg and even to the foot. The area of radiation is along the branches of the lumbar plexus.

The pain is often crushing and may be accompanied by a distinct rigor and even elevation of temperature; nausea and vomiting are common. The secretion of urine is diminished and the patient sweats profusely during a paroxysm; when the obstruction has passed there is usually a profuse flow of urine, and he may be quite conscious of something having "given way" and dropped into the bladder. Attacks of renal colic may be frequently repeated, either because other stones descend or because (as with gall-stones, see p. 371) the same stone makes, as it were, frequent but ineffectual attempts to escape; this is to be suspected if no history of a small stone having been voided is forthcoming, and none is present in the bladder.

Treatment of renal colic.—At the commencement of an attack the bowels should be acted on by a glycerine enema, and the patient placed in a hot bath or have hot fomentations applied to the loin. Pain must be subdued by morphia hypodermically or, if this fails, by the inhalation of chloroform, which should not be pushed to complete general anæsthesia. The patient should be encouraged to drink plenty of water or barley-water, and diuretics, such as the citrate of potash, may be freely given to increase the *vis à tergo* and so facilitate the passage of the stone.

When the attack is over the patient should be instructed to note carefully if he passes a small calculus *per urethram*, and should he do so he should preserve it in order that its nature may be determined. Should no calculus be passed and signs of vesical irritation manifest themselves the bladder must be examined with the sound (p. 552).

Symptoms of stone in the kidney—Pain.—In addition to possible attacks of renal colic the patient usually complains of a dull, heavy, aching pain in the loin which may radiate along the lumbar plexus and is liable to exacerbations, especially after violent exercise. The pain is sometimes very severe, especially when the patient is jolted as in driving; occasionally stooping excites it. It is important to remember that in rare cases the pain is referred to the opposite kidney, and is so often referred to the bladder that an examination of this becomes necessary.

Hæmaturia.—As a rule calculus in the kidney excites but little hæmorrhage, although this may be a marked symptom if the stone be rough and freely movable; it is liable to be increased by exercise. Blood may never be passed, or only in such slight quantities that the microscope is necessary for its detection. The blood is intimately mixed with the urine.

Pyuria.—When pyelitis is present the urine will contain pus or muco-pus. The amount of pus may be small or large and often varies from time to time, indeed for some days the urine (which is usually acid) may be practically free from it.

Intermittent pus in acid urine practically always indicates unilateral pyelitis, and since this is, with few exceptions, due to calculus, it must be regarded as a most important diagnostic sign. It is not uncommon to find that the temporary absence of pus from the urine is accompanied by a considerable increase in the pain, and its reappearance by a diminution; this is to be explained by the calculus shifting its position and temporarily blocking the ureter, the accumulation of pus and urine behind the obstruction produces tension and consequently the distress is increased. The pus-laden urine is sometimes extremely offensive, and may resemble pea-soup.

Frequency of micturition may or may not be experienced.

Quantity of urine and urea.—The quantity of urine may be diminished, but is sometimes increased if chronic nephritis be present. Provided the kidney be not much damaged or the healthy organ takes on its work, the daily excretion of urea will be up to the normal. If this should fall much below the standard it is evidence that the kidneys are incapable of performing their function to the full, and hence may strike work if by operation one is still further damaged.

Examination of the abdomen.—If a large pyo-nephrosis is present the renal tumour will be detected without difficulty; but in many cases the distension is insufficient to give rise to a definite enlargement, especially if the patient be fat. In nearly all, however, there is some tenderness or even actual pain on pressure in the renal region, which may excite a feeling of nausea. Increased resistance as compared with the other side is a usual and suggestive sign. In very thin people a large stone has occasionally been felt or multiple stones have been felt to grate one against the other; such a thing, however, must be regarded as a clinical curiosity, for it is well known how difficult it is to feel even a large stone in the renal substance when the kidney is actually exposed. Occasionally a renal stone may be detected by the X rays, but the absence of its shadow in the negative does not prove its absence from the kidney. Compensatory hypertrophy of the healthy kidney may cause an increase in size which can be appreciated by palpation.

Constitutional disturbance.—It is often surprising how little impairment of the health can be observed in a patient who for years has suffered from calculous pyelitis and has been in the habit of passing large quantities of pus; indeed the majority of patients with stone in the kidney are in good health. Constant pain, the presence of a large pyo-nephrosis, which occupies the abdomen, are likely to be accompanied by failure in general nutrition, nausea, dyspepsia, and perhaps (especially if decomposition sets in) by hectic fever. The grave symptoms which may be induced by a stone impacted in the ureter will be presently mentioned.

Diagnosis.—It is by no means uncommon that an operation is undertaken for the removal of a renal calculus and none is found. The frequency of this occurrence is sufficient evidence of the difficulties which may surround the diagnosis. It has been already stated that the symptoms may be referred to the opposite side, and if any reasonable doubt exists as to the kidney which is affected, the cystoscopic examination and catheterisation of the ureters may serve to locate the mischief.

A highly acid state of the urine, such as may occur in gouty persons, and the passage of large quantities of uric acid or other salts may excite symptoms very similar to those of calculus before pyelitis has set in. Such symptoms, however, usually subside if the patient be carefully dieted and be given alkaline and diuretic drinks.

Tubercular pyelitis is also likely to be mistaken for that induced by calculus; but the pyuria is constant, caseous material may be passed and sometimes the bacillus may be found (p. 521); moreover, both kidneys are usually affected and the patient not only fails in health but also shows other manifestations of tubercle.

Appendicitis accompanied by chronic abscess extending upwards round the kidney may be differentiated by the history, by the predominant intestinal symptoms, and by the absence of abnormal features of the urine.

Early spinal caries, gall stones with distension of the gall bladder, and other conditions have been mistaken for renal calculus.

The diagnosis of the renal tumour is given on p. 514.

Treatment.—In all cases in which a patient exhibits signs connected with his urinary organs which indicate a tendency to the formation of calculi it is of great importance to carefully regulate the diet and general habits of life so that the liability may be reduced to a minimum. It has already been stated (p. 521) that the fundamental causes leading to the formation of calculi are to be sought in some digestive deficiency, and hence this function must be carefully supervised. In those passing large quantities of uric acid the diet must be simple, plentiful but not excessive, and should not contain too much nitrogenous food. The bowels must be regulated and the action of the kidneys promoted by alkaline drinks, diuretics such as the citrate and acetate of potash, hot water in the morning and at night, the use of lithia water and some form of saline aperient water. But little alcohol should be allowed. The patient should take regular daily exercise. Oxaluria demands a more generous diet and more liberal allowance of alcohol; foods such as acid fruits, salad, etc., which are rich in oxalates should be partaken of sparingly or abstained from.

Surgical treatment.—When the diagnosis of stone has been definitely arrived at no time should be lost in undertaking its removal. Delay is useless, moreover it is dangerous; to wait in the vain hope of the stone passing *per vias naturales*, or to attempt to dissolve it by drugs or waters, is to postpone the inevitable and to buoy up the patient with hopes the falsity of which time will surely prove. Nephro-lithotomy is in itself a safe and successful operation, but circumstances may render it highly dangerous, and in this respect the comparative soundness or otherwise of the kidney, which may be judged of by the history of the case, the general condition of the patient, the state of the urine, and especially by the daily amount of urea excreted, has an important significance.

In some cases a pyo-nephrotic kidney is practically non-existent as a kidney, and its *ultimate* removal may become necessary (see Nephrectomy, p. 534).

CALCULUS IN THE URETER

A calculus may become impacted in the ureter at one of the following situations:—(1) About two inches from its commencement; (2) where it crosses the iliac vessels; or (3) as it passes through the bladder wall (Fig. 162). The severity of the symptoms will depend upon the degree of obstruction which the stone occasions; if this is only partial there will be pain in the loin and along the ureter, especially at one spot; it is often paroxysmal in character as in renal colic; the signs of pyo-nephrosis soon make their appearance. If the obstruction be complete the symptoms are more urgent, and uræmic poisoning will occur if, as is sometimes the case, both ureters are blocked. Examination of the bladder may detect the end of the stone projecting at the orifice of the ureter or it may be felt by rectal or vaginal examination; when it is impacted higher up the seat of the pain, which is much aggravated by abdominal palpation, will suggest its situation.

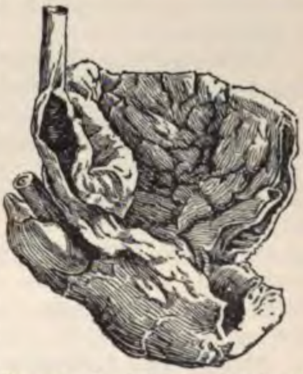

Fig. 162.—A calculus impacted in the lower end of the right ureter (from a specimen in the Westminster Hospital Museum, No. 834. Drawn by C. H. Freeman).

Treatment.—Provided the symptoms are not urgent, time should be allowed in the hope that the calculus will eventually pass. If active treatment is demanded the situation of the stone must determine the course to be pursued. If it is impacted at the vesical orifice it may be broken up and extracted piecemeal by fine forceps after the bladder has been opened above the pubes; in women it may be reached after the urethra has been fully dilated, or by an incision through the vaginal wall. If the stone is at the upper end of the ureter the kidney must be opened and an attempt made to extract it with forceps or press it backwards towards the renal pelvis with the fingers; should this fail, the ureter must be exposed and incised and the stone shelled out; the ureter need not be sutured. A calculus impacted near the brim of the pelvis should be cut down upon by an incision similar to that for ligature of the common iliac artery. If, however, all attempts at removal fail, nephrectomy is the only resource.

NEW GROWTHS OF THE KIDNEY

Innocent tumours of the kidney are occasionally met with *post-mortem*, but, with the exception of the villous papilloma, which sometimes grows in the pelvis of the organ, they do not give rise to symptoms.

Fibro-myomata, adenomata, and **angeiomata** are those which may be specially mentioned; they grow in the substance of the organ, are encapsuled, and never attain a large size.

Villous papilloma exactly like that met with in the bladder occasionally, though rarely, grows within the pelvis of the kidney, and causes symptoms similar to those of calculous pyelitis, but is frequently associated with severe hæmaturia. Particles of the growth may be detected in the urine. These tumours may excite pyelitis and pyo-nephrosis, especially if they partially block the ureter. Papillomata may be removed by exposing the kidney and opening up its pelvis from behind.

Malignant tumours.—Glandular **carcinoma** and various forms of **sarcoma** may occur in the kidney as primary or secondary growths. Primary sarcomata are often mixed with voluntary muscular tissue (*rhabdomyoma*). Primary malignant disease is usually met with in young children, but may occur in adults; it affects the right rather than the left kidney. These tumours grow with great rapidity, and may extend into and block the ureter. Profuse hæmaturia, pain, general failure of the health, and the presence of the renal tumour are the diagnostic features. The pain radiates over the abdomen and towards the groin, and may be of a distinctly colicky nature, especially if the growth extends into the ureter or this becomes blocked by a blood-clot. The urine contains blood and pus, and sometimes the cells of the growth may be found. Frequency of micturition is usually present, and as the tumour increases in size dyspeptic symptoms with vomiting and constipation are very troublesome. Peri-nephritic abscess sometimes occurs.

Treatment.—The relief of pain and the employment of ergotin or turpentine to diminish the bleeding is the only treatment. Removal of the kidney has in almost every case been followed by rapid involvement of the glands and death, and is practically abandoned as useless. If suppuration occurs round the organ the abscess must be opened and drained.

CYSTS OF THE KIDNEY

Simple cysts.—Small retention cysts are often present in cases of renal cirrhosis; they are usually situated beneath the capsule, and are so small that they have no clinical symptoms or importance.

Large cysts of doubtful origin are sometimes met with, growing in connection with some part of the surface of a kidney which may be perfectly healthy. The cyst wall is thin and translucent; the fluid is watery and contains albumen but no urinary elements; sometimes it is mixed with blood and rarely contains colloid material. The symptoms are proportional to the size of the cyst, and are merely due to its mechanical effects; there are no urinary changes or signs of renal disease. The diagnosis of a cyst is usually easy, but that of its actual seat is by no means so.

Treatment consists in laying open and draining the cyst through the loin.

Cystic degeneration of the kidney.—In adult life the kidneys are sometimes converted into a mass of cysts lined by a layer of polygonal epithelium and separated from one another by a varying amount of fibrous tissue. The cysts contain a watery fluid which may be clear or turbid, but does not contain any urinary elements; sometimes the contents are colloid. The kidneys are much enlarged, and are lobulated on the surface; on section the cystic spaces give the whole organ a sponge-like appearance. The cysts seem to originate by dilatation of the renal tubules and very little renal substance may be present.

Similar cysts may be met with in the liver and brain, and cardiac hypertrophy is often associated.

In its clinical history cystic disease bears a great resemblance to granular kidney, but œdema is rarely present and the urine frequently contains blood. Examination will reveal the existence of a large tumour in each renal region. The prognosis is very grave, and the patient may die of uræmic poisoning.

Treatment is not available owing to the bilateral nature of the condition.

Congenital cystic degeneration (Fig. 163) of the kidney may be associated with some other congenital defect. The kidney is in much the same condition as that just described. The cysts are retention cysts, but their method of origin is doubtful; some consider that they arise in connection with the tubules of the permanent kidney, others that they do so from the tubular remains of the Wolffian body. The fact that the cysts contain urine supports the former opinion but does not exclude the latter, since such tubular remains might perform the functions of the permanent renal tubules.

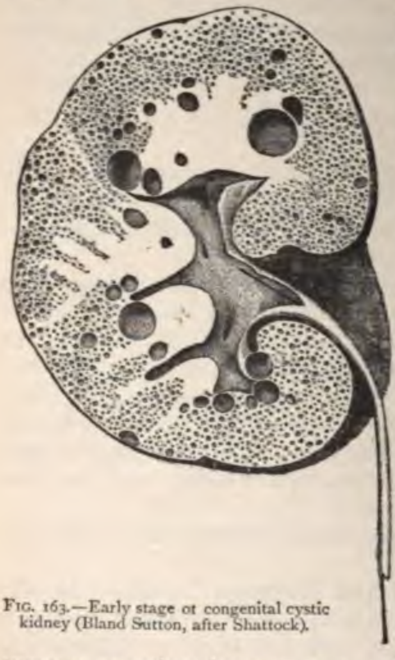

FIG. 163.—Early stage ot congenital cystic kidney (Bland Sutton, after Shattock).

The condition is one of pathological interest rather than of clinical importance.

Hydatid cysts occasionally occur in connection with the kidney and give rise to similar symptoms to those produced by the large cystic tumours mentioned on p. 529. A hydatid cyst may burst into the colon or pelvis of the kidney, and the discharge of daughter cysts will then clear up the diagnosis; bursting into the pelvis of the kidney may be accompanied by renal colic. The diagnosis can be confirmed by aspiration.

Treatment.—If possible the cyst should be removed, but in the majority of cases this cannot be done, and free incision and drainage is the only means at our disposal.

OPERATIONS ON THE KIDNEY

The lumbar incision.—When operating on the kidney through the loin the patient must be rolled over on to the sound side, beneath which a firm pillow or sand-bags must be placed, so that the space between the iliac crest and the last rib on the diseased side is opened out as much as possible. An assistant should steady the legs and thus prevent the patient from rolling over.

By the lumbar route the kidney is exposed by an incision running transversely from just below the tip of the last rib backwards to a little beyond the edge of the erector spinæ, and if additional room is wanted a second incision may be made from the centre of this down to the crest of the ilium. The structures are divided as in lumbar colotomy, the edge of the quadratus lumborum being notched if necessary. By tearing through the transversalis fascia and the peritoneal fat the kidney is exposed, and the necessary operation on it can then be carried out. In fat patients the difficulty of exposing the kidney so that it can be easily manipulated is often very great, and additional room, obtained as above directed, is requisite. The kidney may be pushed up into the wound by an assistant pressing on it through the abdominal wall.

NEPHRORRHAPHY

When the kidney has been exposed it is sutured in the following way:—A nævus needle armed with a suture of kangaroo-tendon or silk is passed through the muscles at the hinder end of the upper lip of the wound, then through the kidney about half an inch from its outer border, and finally through the muscles in the front part of the wound, the needle being un-threaded and re-threaded as each stage is accomplished. A similar suture is passed at the lower part of the wound, and additional ones may be employed if necessary. If there is a complete meso-nephron, the peritoneal cavity is necessarily traversed by the suture, but under proper aseptic precautions this will do no harm.

The sutures are tied and the kidney is thus well drawn up and anchored to the side. The wound is closed and should be left alone for ten days. It is advisable to keep the patient in the dorsal position for about a month. Some surgeons prefer to let the wound heal by granulation in the hope of more securely fixing the kidney; but if sufficient rest be given this does not seem necessary.

NEPHROTOMY

Nephrotomy consists in exposing, laying open, and draining the kidney. When the organ is reached (p. 531) an incision is made into it posteriorly, and the finger is introduced with the view of detecting a stone which may be present. A flanged drainage tube is introduced and the anterior part of the incision through the loin is then sutured. If the pus and urine which escapes is very foul, the sac should be gently irrigated with sterilised water to which a little iodine may be added with advantage. If the obstruction which caused the pyo-nephrosis cannot be removed a urinary fistula will result, and this will necessitate a subsequent exploration of the kidney or nephrectomy.

NEPHRO-LITHOTOMY

When the kidney has been exposed (p. 531) and has been pushed well up into the wound by the assistant, the surgeon passes his finger behind it, and systematically palpates the organ and its pelvis. By this means the stone may be detected, but is often missed even when of considerable size; should it be found the renal substance over it is at once divided. If palpation gives a negative result, the kidney must be punctured in several places from end to end; should a stone be discovered by this means an incision is made over it. When the stone is not found by palpation or needling, the posterior surface of the kidney should be opened by a small incision near the pelvis; this can be enlarged by the finger which is introduced into the pelvis for the purpose of exploring it and the upper part of the ureter. Incision of the kidney, unless it has been converted into a large pyo-nephrosis, causes bleeding, which may be very profuse, but usually stops in a few minutes if sponges be crammed into the wound while the kidney is pressed well up into it through the abdominal wall. When the stone is found it may be coaxed out of the kidney by the finger, or may be seized with forceps and extracted; if it is large and branched it may require breaking up before it can be removed, but whenever possible this should be avoided, as by so doing fragments may be left behind. On its removal the stone should be examined for facets, and any others which may be present must be taken away. Sometimes the calculus will be found impacted in the upper end of the ureter, its position being ascertained by palpation or by the probe introduced through the renal wound; it must be seized with forceps such as are used for the urethra and removed, or it may be broken down and removed piecemeal; in the event of neither of these methods proving successful, the calculus must be removed by an incision through the ureter, which will not require suturing. When the operation has been completed, a drainage tube is passed into the hinder end of the wound and into the pelvis of the kidney itself if pyo-nephrosis is present; it must be gradually shortened, but should not be dispensed with until the discharge through the loin is practically only urine. If the renal wound bleeds much in spite of pressure it should be plugged with gauze for a few hours. The anterior part of the wound in the loin should be sutured.

Difficulties and dangers of the operation.—If the patient is very fat, it will be necessary to gain additional room by making the incision down to the iliac crest, and the kidney must be pushed well up into the wound by the assistant. The stone is not by any means always easy to find and may be missed even in a kidney which is not enlarged; when the organ is much dilated, the stone may lie in a calyx or recess quite out of the reach of the finger; should this be the case, the opening may be further enlarged and an endeavour be made to locate and remove the stone by probe and forceps; but, failing this, the kidney must be well drained, and when it has contracted down to a more nearly normal size a further exploration must be made, when the stone will usually be easily detected; failing this, the organ must be removed.

If the kidney is found to be much diseased, and the pelvis full of putrid urine and pus and coated with phosphatic material, nephrectomy will be necessary, especially if the stone cannot be reached, and under such circumstances may be done at once, and thus the possible occurrence of septic peri-renal inflammation from contamination by the putrid material will be avoided.

When the kidney is not in an advanced state of disease, and when the other is sound, nephro-lithotomy is a very safe operation, but such adverse circumstances may be very dangerous.

Shock, especially if there has been profuse bleeding, may prove fatal, but rarely does so. Septic peri-renal inflammation may be lighted up if the kidney contains putrid fluid, and especially if the cellular planes have been opened up widely by the fingers during the operation. Death from uræmia may occur if both kidneys are diseased.

After-treatment.—The dressings must be frequently changed, as they become saturated with urine and blood. If the kidney has been converted into a pyo-nephrosis, gentle irrigation with weak boracic solution or sterilised water may be employed for a few days, until the discharge becomes healthy and but slight in amount. For the first couple of days the urine passed by the urethra will be bloody; if it is not so, it is proof that the ureter is blocked, and further treatment will become necessary. Examination of the urine passed by the urethra will afford valuable evidence as to the condition of the other kidney. For the first few days the diet should mainly consist of milk, with a little beef tea and plenty of barley water if there be much thirst.

NEPHRECTOMY

Removal of the kidney may be required—(1) when it is extensively diseased as the result of calculous pyo-nephrosis; (2) in rare cases in which, although the presence of a stone is certain, it cannot be found; (3) tubercular disease rarely permits removal of the organ owing to the affection being usually bilateral and frequently associated with disease of the genito-urinary tract or lungs; (4) for a persistent and troublesome urinary fistula after nephrotomy or nephro-lithotomy; (5) for severe crushing injuries of the organ with extensive hæmorrhage; (6) for rupture of the ureter leading to its impermeability and a collection of urine behind the peritoneum (see p. 339, vol. ii.). Nephrectomy for malignant disease is practically abandoned (p. 529). Before undertaking the operation of nephrectomy, it is of the utmost importance to determine as far as may be the practical integrity of the other kidney; unfortunately this is by no means always easy. The question must be determined by a careful estimation of the daily excretion of urea, which, if the kidney to be removed is being drained, will give a fair estimate of the work done by its fellow.

Much discussion has taken place regarding the route by which the kidney should be removed, but there is no doubt that, provided the size of the organ be not too great, the lumbar retro-peritoneal operation should be performed; the advantages claimed for the abdominal method are by no means so great in practice as in theory, and its disadvantages are obvious.

Lumbar nephrectomy.—The kidney is freely exposed by the T-shaped incision (p. 531), and is then freed from its surrounding fat, but if it is adherent to this owing to peri-nephritis, the capsule of the organ is incised along its outer border, and is then peeled off it and left behind. While isolating the kidney, care must be taken not to use unnecessary violence, or the bowel, peritoneum, vena cava, or renal vessels may be torn, with fatal consequences. When the kidney has been isolated the ureter is defined, ligatured in two places, and divided between; the lower end is then examined, and the mucous membrane is touched with pure carbolic acid to ensure its ascepticity. The bundle of renal vessels is now transfixed by a blunt needle (care being taken that this is not pushed through one of the branches), and is ligatured with silk in two halves. The pedicle is divided about half to three-quarters of an inch from the ligatures, and the kidney removed. Any bleeding points are secured and the wound is closed, a small drainage tube being introduced behind.

Abdominal nephrectomy must be performed when the size of the kidney is such that its removal by the loin is impossible. The kidney is reached by an incision in the linea semilunaris, which opens the peritoneal cavity. The intestines are pushed aside, and the pedicle of the kidney is exposed by dividing the peritoneum over it. The kidney is isolated; the ureter is first double ligatured and divided, and the vessels are then tied and the pedicle is cut across. A counter-opening for drainage should be made in the loin, and the abdominal wound closed. A modification of this operation consists in cutting through the abdominal wall as far as the peritoneum, which is then pushed towards the middle line (as in ligature of the external iliac artery), and the kidney is removed from behind it; and should this be found practicable, it is certainly the wiser course.

Dangers of nephrectomy.—The operation may prove directly fatal from shock, or from suppression of urine with uræmia if the other kidney is not sound.

Septic cellulitis and peritonitis may prove fatal at a later date. If the incision has been prolonged upwards to the ribs, the pleural cavity may be opened and empyema may ensue.

CHAPTER XXIV

DISEASES OF THE BLADDER

Anatomy.—The bladder is covered by peritoneum on its posterior and upper part, the membrane being reflected from it above along the urachus and obliterated hypogastric arteries, and behind at the place where the ureters pass through the wall of the viscus. If the organ be fully distended, and especially if it be pushed up by distending the rectum, it rises well above the pubes, so that it may be opened in this situation without risk of wounding the peritoneum. The muscular tissue is arranged in three layers, external and internal longitudinal and middle circular; the internal layer is thin, and at the vesical orifice the circular fibres are abundant and form the sphincter vesicæ. The submucous coat is very loose, and consists of areolar tissue with elastic fibres. When the bladder is contracted, the mucous membrane is thrown into folds, except at the trigone; it is very delicate and soft, covered by stratified epithelium, and is richly supplied with blood-vessels and nerves. The ureters pass obliquely through the bladder wall in which they run for about three-quarters of an inch; this course through the muscular fibres prevents reflux of the urine from the bladder to the ureters. In the male the neck of the bladder is surrounded by the prostate.

HYPERTROPHY AND DILATATION OF THE BLADDER

When any chronic obstruction to the free flow of urine exists, provided it be of such a nature that it can be overcome by increased force, the muscular coat of the bladder will hypertrophy, but should this fail to compensate for the obstruction, dilatation will follow. In cases of enlarged prostate, increased force of the muscular contraction will not serve to overcome the obstruction caused by the middle lobe, but will, as stated on p. 567, rather tend to increase it, consequently hypertrophy is but little marked, although the retained urine may cause very considerable dilatation. Hypertrophy may also ensue on long-continued cystitis, independently of any organic obstruction in the urethra, the thick viscid mucus requiring increased force for its expulsion. Chronic inflammation may induce considerable thickening of the mucous and submucous coats, which must not be mistaken for true hypertrophy.

The muscular bundles are much increased in size, and form prominent ridges, with intervening depressions which may develop into definite sacculi. These ridges render the bladder fasciculated.

Since the ureter passes obliquely through the muscular coat of the bladder, the effect of hypertrophy will be to constrict its outlet, and hence there is obstruction to the free flow of urine from the ureter and consequent hypertrophy, followed by dilatation of its walls, and the condition may be so marked that hydro-nephrosis, with perhaps inflammatory changes in the kidney, may result (see p. 507).

Dilatation of the bladder necessarily follows on hypertrophy should this fail to compensate, but it may also be a primary condition in cases of habitual neglect of the call to micturate, or in which the bladder wall is partially or completely paralysed, and retention of urine habitual.

SACCULATION OF THE BLADDER

When the bladder is fasciculated, the mucous membrane becomes gradually pushed outwards between the hypertrophied muscular bundles, and hence cyst-like pouches result. These may be multiple and small, or may be even larger than the true bladder. The larger sacculi are usually situated close to the opening of the ureter and project backwards between it and the middle line; the wall is thin, and composed of mucous membrane and peritoneum, but there is no muscular tissue, or only a very thin layer; sometimes the wall is thickened by new fibrous tissue as the result of chronic inflammation. The opening by which the sacculus communicates with the bladder is usually small and circular. Inflammation of the bladder will spread to the cavity of the sacculus, and as the urine is to some extent retained in this owing to the absence of muscular tissue in the walls, phosphatic concretions are liable to form, and encysted calculi result; or the inflammatory state may originate in the sacculus owing to decomposition of the retained urine.

Sacculation of the female bladder is very rare, owing to the freedom of women from obstructive disease.

The presence of a sacculus may sometimes be determined during life provided the first urine passed is quite clear and apparently healthy, and is then followed by turbid urine with thick mucus; or, if the sacculus be very large, it will be found that when the bladder has been apparently emptied dulness is still present in the supra-pubic region.

A sacculus may be ruptured by forcible injection of the bladder or by the rough use of instruments.

ACUTE CYSTITIS

Causes.—Acute cystitis may be due to the presence of a calculus or foreign body, to the introduction of septic material by means of instruments, or to extension of gonorrhœal urethritis. It may also follow operations on or injury of the viscus, or be the result of a fistulous communication with the gut. In gouty persons a condition of vesical catarrh is not uncommon, and the same may be induced by cantharides or turpentine taken internally; from these causes the ensuing trouble is insignificant, and under appropriate treatment passes off in a few days.

In cases of spinal injury a very severe form of cystitis, often culminating in sloughing of the mucous membrane and speedy death, may result from interference with the trophic nerve supply (see vol. ii. p. 278).

Morbid anatomy.—The inflammation affects the mucous membrane, and very rarely extends to the muscular coat. It is most marked at the trigone and neck of the bladder.

The membrane is swollen, intensely congested, and of a bright scarlet colour; minute extravasations of blood are not uncommon. In some cases the inflamed surface becomes covered with a false membrane composed of fibrinous exudation, muco-pus, desquamated epithelium cells, micro-organisms, and phosphates; this ultimately separates, and exposes the raw tissue beneath. Such a membrane may be passed in large shreds or remain in the bladder until removed by the surgeon; its spontaneous expulsion is more likely to occur in women, owing to the shortness and capacity of the urethra.

In severe cases minute abscesses may form and, bursting, give rise to isolated patches of ulceration; in the worst cases, especially seen after spinal injury, the mucous membrane may slough, and perforation of the bladder is occasionally seen.

Symptoms.—The gravity of the symptoms and the rapidity of their onset vary with the intensity of the inflammation. In well-marked cases, such as are excited by the introduction of septic matter, the onset is sudden, and may be ushered in by chills or a distinct rigor. There is great irritability of the bladder, with frequent micturition and strangury; the call to micturate is imperious, and the act is preceded by intense pain at the neck of the bladder, in the supra-pubic region, and sometimes in the perineum. The pain quickly subsides as soon as a few drops of urine have been voided, only to return when a little more has accumulated.

The supra-pubic region is very tender, and pressure causes acute pain. The urine is alkaline, high-coloured, and turbid from admixture with inflammatory exudation and shed epithelial scales; sometimes it resembles thin pea-soup. It is albuminous, often bloody, and contains a considerable quantity of thick viscid muco-pus.

In acute cases there may be considerable constitutional disturbance, although the temperature may not rise more than one or two degrees. If marked general symptoms are present, prostatic or renal complications should be suspected. In the worst cases, when the mucous membrane becomes gangrenous, the patient may die from perforation or peritonitis,—fortunately such an occurrence is very rare. The acute symptoms usually subside in a few days, and the inflammation passes into a subacute or chronic state.

The prognosis of acute cystitis depends largely upon its cause, the age of the patient, and the presence or absence of renal disease.

Treatment—Preventive.—The occurrence of acute cystitis from the introduction of septic material by means of catheters, etc., ought never to occur, for such instruments should always be most thoroughly cleansed before and after use (p. 570). In cases of gonorrhœa, extension backwards should be prevented by early and careful treatment of the disease from its commencement and by refraining from the use of a catheter by which septic material may be passed on to the bladder from the urethra.

Curative.—The patient must be confined to bed, and the bowels freely acted on by saline aperients or enemata. The hot hip-bath is invaluable, and should be used for twenty minutes at a sitting, to be repeated every four hours or so, and hot fomentations must be applied to the supra-pubic region in the intervals. Belladonna and morphia suppositories are useful for the relief of strangury and pain. Internally the citrate of potash, liquor potassæ, fresh infusion of buchu, uva ursi, or triticum repens may be given, and barley-water allowed *ad lib.* During the acute stage the diet should be of a fluid nature, milk being the chief nourishment.

If the cystitis be dependent upon the presence of septic material, the sooner it is removed by washing out the bladder with dilute boracic solution the better, for so long as the septic condition remains the inflammation will continue. In some cases the mere presence of a calculus or foreign body may keep up the inflammation in spite of rest and treatment, and its removal is then urgently called for.

CHRONIC CYSTITIS—VESICAL CATARRH

Causes.—Chronic cystitis may follow the acute form, or may be chronic from the first. Its most common causes are some mechanical irritant or tumour in the bladder, and long-continued retention with decomposition of the urine as the result of enlargement of the prostate or stricture of the urethra.

Morbid anatomy.—In consequence of repeated congestion and inflammation, the mucous and submucous coats are infiltrated with inflammatory exudation, and pigmented by altered blood. The pigmentation is unequally distributed, and hence the surface of the mucous membrane has a mottled appearance. The swollen and thickened membrane loses its suppleness and elasticity, becomes an ashen grey colour, and may be studded with areas of superficial ulceration, especially noticeable on the summits of the rugæ. The surface may be coated with viscid, ropy mucus, mixed with phosphates.

Symptoms.—The symptoms of chronic cystitis are similar in character, but less severe in degree, to those met with in the acute disease. The frequent micturition with strangury is aggravated by the difficulty experienced in passing the thick ropy mucus. The urine is alkaline, ammoniacal, and often extremely offensive; there is pyuria, and much ropy mucus, with phosphates, comes away with the urine. The mucus especially comes away with the last quantity of urine passed, the first portion being, although turbid, much clearer and healthier in appearance.

The constant call to micturate and the accompanying pain have a profound effect upon the patient's general health, more especially as his night's rest is constantly broken.

Acute cystitis may at any time supervene on the chronic disease and threaten the patient's life, especially if he be old and his kidneys are diseased.

Treatment.—In all cases of chronic retention of urine the greatest care must be taken to periodically empty the bladder by means of a perfectly clean catheter, so that decomposition of stagnant urine cannot occur, and all sources of irritation or retention, *e.g.* calculus or stricture, should be removed.

When the disease is established, the bladder should be washed out at least once, and preferably twice, daily after the urine has been drawn off. For this purpose a warm solution of boracic acid (4 gr. ad ℥i.) is the best. The eye of the catheter should be of good size, in order that the thick ropy mucus may easily escape, and the washing should be carried out slowly and gently, so as to avoid pain. About two ounces should be injected at a time, and allowed to run away before any more is introduced, and the washing should be continued until the fluid comes back clear. After this about ʒi. of iodoform emulsion should be injected into the bladder, and the catheter withdrawn.

Quinine, gr. 2, or silver nitrate, gr. ¼ to the ounce of water, or weak Condy's fluid, may be used in place of the boracic acid solution. If there be a deposit of phosphatic material in the bladder, a dilute acid solution (acetic 10♏, or dilute nitric 3♏ ad ℥i.) may be useful, and can be made less irritating and painful by the addition of lead or opium.

Boracic acid internally, in 15-grain doses, should be given thrice daily, the urine rapidly improving under its use. The drugs recommended in the treatment of acute cystitis may also be useful in the chronic form, and suppositories are sometimes required to relieve spasm and pain.

Plenty of good fluid nourishment is necessary, especially for those broken down in health by chronic disease of the urinary organs. If under the above means the patient's local and general condition do not rapidly improve, continued drainage of the bladder by catheter or by a supra-pubic or perineal opening (often combined with irrigation) must be resorted to. If the bladder is opened, the mucous membrane should be swabbed over with a solution of nitrate of silver, 20 grs. ad ℥i.

TUBERCULAR CYSTITIS

Tubercular disease of the bladder is usually met with in conjunction with a similar condition of the kidney or prostate, but occasionally occurs as a primary manifestation.

It is much more common in men than women.

Morbid anatomy.—The mucous membrane, especially at the trigone, is infiltrated with tubercular nodules which degenerate break down, and lead to superficial ulceration. As the disease advances adjacent tracts may coalesce and extension take place in superficial area and depth, so that the muscular coat is invaded and the cellular tissue round the bladder may become involved. By gradual extension in depth fistulous communications with the bowel or vagina may be formed.

Symptoms.—The symptoms are those of intractable chronic cystitis. At first they are more or less masked, but gradually increase in severity as the disease progresses. Pyuria and perhaps slight hæmorrhage are present when the tubercular tissue has broken down. There is but little if any pain. Examination will probably reveal the presence of tubercle elsewhere, especially in the prostate or vesiculæ seminales. The bacillus may occasionally be detected in the urine after centrifugalisation, but its absence is no proof that the cystitis is not of tubercular origin. In doubtful cases inoculation of a guinea-pig with the sediment from the urine will probably clear up the diagnosis.

Tubercular cystitis, occurring as it does in association with tubercle elsewhere, and being beyond the reach of active surgical treatment, is a serious disease, and although it may persist for a long time the patient usually succumbs.

Treatment.—But little can be done locally. Washing out the bladder or instillation of drugs is not productive of any marked benefit unless there is general cystitis. Iodoform emulsion may be instilled each night, and in cases under my care has certainly given considerable relief.

It has been proposed to scrape the tubercular ulcers through a supra-pubic cystotomy wound, but in view of the fact that the disease is but rarely limited to the bladder, the benefit to be derived is questionable.

The general treatment is that for tubercle. A sea-voyage or residence in a good bracing air should be resorted to if possible

TUMOURS OF THE BLADDER

All tumours of the bladder are more common in men than women. They usually occur after thirty years of age, but sarcoma is occasionally met with in children, and the mucous popypus is peculiar to them.

Innocent tumours—**Fibroma, lipoma, enchondroma and**

myoma are all so rare as to need no further mention; the **mucous popypus** occasionally met with in children is similar in structure to that met with in the nose, but is denser.

Papilloma or villous tumour (Fig. 164) is the commonest form of growth met with, and usually springs from near the orifice of one of the ureters. In its simplest form it consists of long slender branching processes composed of delicate connective tissue covered with several layers of epithelium; the processes are supplied by a minute central artery, and are highly vascular. The villi float freely in the urine and are united at their bases, so that the tumour is usually broadly sessile, but sometimes it springs from the mucous membrane by a distinct pedicle, while in other cases fine villous processes are freely scattered over the entire mucous surface. The villous processes may not form such a prominent feature of the growth, which is largely composed of fibrous and unstriped muscular tissue, and, growing slowly, may form a dense solid mass of considerable size, the surface of which is however covered with short villi (*fibro-papilloma*). In other cases such a growth is largely composed of round cells and embryonic tissue, thus approximating to the

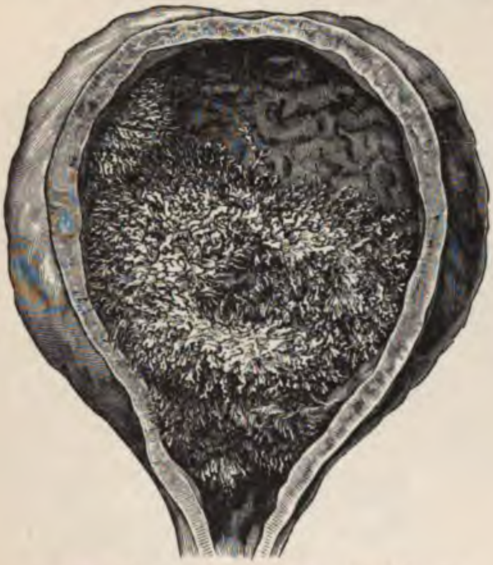

FIG. 164.—Villous tumour of the bladder (Bland Sutton).

sarcomata; such growths have been named by Thompson *transitional tumours*. It may be mentioned here that sarcomata, epitheliomata, and the rare forms of innocent tumour are frequently beset by villous processes, and hence the discovery of such in the urine is not proof positive of the benign nature of any growth.

As a tumour grows it may more or less occlude the orifice of the ureter, and thus occasion secondary changes in that tube and the kidney.

Symptoms.—An innocent tumour may exist for a long time without producing symptoms of its presence, but sooner or later hæmorrhage, *unattended by pain or cystitis*, attracts attention. The first urine passed may be quite clear, but it gradually becomes more and more bloody, until finally almost pure blood with small clots, may be voided. As the tumour increases in size the bleeding, which may at first be trivial and only repeated at considerable intervals, becomes more profuse and may occur with every act of micturition, and be in such quantity as to seriously imperil the patient's life. The hæmaturia often recurs without apparent cause,

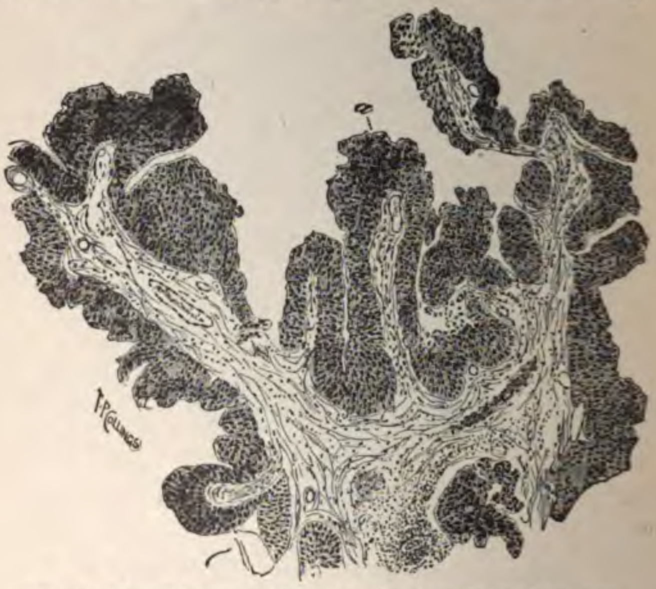

Fig. 165.—General microscopic view of a portion of a papilloma of the bladder (Sir Henry Thompson).

and unlike that attending stone is not usually occasioned by exercise; over-distension of the bladder may produce it doubtless from stretching and tearing the base of the growth; the introduction of instruments may also occasion profuse bleeding. There is usually some increased frequency of micturition, and it occasionally happens that the flow is suddenly diminished or arrested, and pain is excited in consequence of the long villous processes being carried by the stream into the vesical outlet. Cystitis may be long deferred, but as the tumour increases in size it will sooner or later ensue; its advent considerably aggravates the symptoms, diminishes the chances of a successful operation, and endangers the patient's life, not only on account of the serious local condition, but by the possible occurrence of renal complications.

The patient's health suffers in proportion to the amount of hæmaturia, and when cystitis supervenes the constant pain and irritation and broken rest may reduce him to a dangerously low ebb.

In suspected cases the urine must be diligently examined for detached portions of growth, the discovery of which is diagnostic of its presence but not necessarily of its nature, for as already pointed out any tumour, innocent or malignant, may be associated with the growth of villous processes. If repeated examination results in negative information the bladder should be gently washed out through a large-eyed catheter, when portions of growth may be found in the washings or entangled in the eye of the instrument. In ordinary cases rectal or vaginal examination will not reveal anything abnormal, but if the tumour be of considerable size and density, it may be felt as an indurated mass in the bladder wall. When the diagnosis cannot be arrived at by the means indicated, the cystoscope may be used, but its value has, I think, been considerably over-estimated. The cystoscope can only be available in cases in

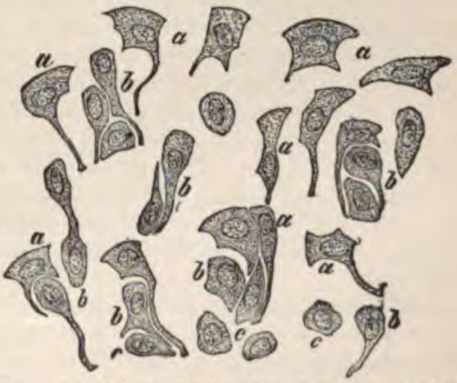

FIG. 166.—Vesical epithelial cells for a fragment of a papilloma evacuated with the urine (*a*) superficial, (*b*) central, (*c*) deep cells (Ziegler).

which the fluid medium in the bladder is clear, and in the case of tumour at any rate the frequent admixture of blood, especially on the introduction of instruments, renders the instrument useless.

Prognosis.—If an innocent tumour has been discovered early and is removed the prognosis is good, but if its presence has been overlooked until cystitis has been set up, and especially if renal complications are present, the danger of operation is considerable, and success is by no means certain. Long-continued and profuse bleeding diminishes the patient's general health and resisting power, and is an unfavourable element in the case.

Treatment.—Early removal by supra-pubic cystotomy is imperative. When the bladder has been opened as described on p. 557, it must be well drawn up into the wound and emptied of fluid by careful sponging or by a syringe. An ordinary Fergusson's speculum or a specially constructed instrument is then introduced over the tumour, in order to completely isolate it, and thus the surgeon is enabled to keep the field of operation dry and see what he is about. Pedunculated growths are easily twisted off with appropriate forceps, but if the tumour is sessile the base must be further carefully snipped away with curved scissors, every precaution being taken against cutting too deeply or the bladder wall may be perforated with a fatal result. The bleeding is free, but can usually be easily arrested by sponge pressure or ice-cold water; emptying the rectal bag, and so relieving pressure on the veins serves to materially diminish the bleeding. On the completion of the operation a large drainage tube must be introduced, but may usually be removed by the third or fourth day. In the majority of successful cases the wound is healed by the third week.

Treatment of tumours in women.—Small growths may be removed through the dilated urethra, but larger ones require supra-pubic cystotomy.

Malignant tumours.—**Sarcoma** of the bladder is rare and may be met with at any age, even in young children. **Epithelioma** is more common, and occurs after forty years of age; it is much more frequent in males than females. The bladder may be secondarily involved by malignant disease of the rectum or of the gut higher up, of the prostate, vagina, or uterus.

Malignant tumours grow rapidly, and gradually invading the bladder wall spread to surrounding parts and the lumbar glands. Epithelioma especially attacks the trigone, and at first forms a flattened raised mass with a somewhat irregular and nodular margin; as it grows it may encroach considerably upon the cavity of the bladder.

Symptoms.—The symptoms are similar to those met with in the case of an innocent tumour, but they are to some extent modified. Thus when hæmaturia has occurred it is usually more continuous, and does not show the marked remissions met with in innocent growths. Pain is more severe and constant and, moreover, occurs before the onset of cystitis, and the frequency of micturition becomes more evident as the tumour increases in size and occupies a considerable part of the bladder cavity. Retention of urine may be occasioned if the growth spreads to the neck of the bladder and along the prostatic urethra.

Examination by the rectum or vagina, except in very early cases, will usually reveal an indurated mass in the bladder, and possibly some matting of the surrounding structures.

By microscopic examination of the urine large masses of epithelium cells and villous processes (which may be associated, p. 544) may be detected.

The general health of the patient suffers in a marked degree, and this is specially noticeable when cystitis is present.

Treatment.—No operative treatment aimed at removal of the growth can be of any benefit. If the hæmaturia is excessive an attempt must be made to check it by the internal administration of ergot, iron, hamamelis, sulphuric acid and opium, or other hæmostatics, but their employment is too often disappointing; local injections of hamamelis or nitrate of silver (gr. ¼ ad ℥i.) may be more servicable.

Opium may be freely given if the patient suffers much pain. So long as he can enjoy comparative comfort without the use of the catheter, it should be withheld, for its use may cause considerable irritation and excite bleeding; but if the frequency of micturition is great, the bladder occupied with blood-clot, or cystitis be present, its use becomes imperative, and if this fails to afford adequate relief, a small supra-pubic opening should be made and free drainage employed.

When cystitis is adding to the patient's sufferings, gentle washing out with boracic solution should be resorted to, but great care must be taken that hæmorrhage is not excited.

STONE IN THE BLADDER

A calculus may primarily originate in the bladder, but usually descends into it from the renal pelvis and subsequently increases in size (see p. 521).

Stones formed in the bladder consist almost entirely of phosphates, and owe their origin either to the presence of a foreign body or to some other cause exciting cystitis with decomposition of the urine and precipitation of its salts. The probability of the formation of stone is increased if there is mechanical obstruction to the flow of urine, for this not only aggravates the cystitis but imprisons within the bladder an accumulation of ropy mucus and phosphatic material. When once a stone has formed, its increase in size by the deposition of phosphates and other salts is easy of comprehension, in view of the cystitis its presence occasions.

The chemical composition and physical characters of calculi.—**Uric acid calculi** are very common, especially in the gouty and over-fed whose digestion is defective. These stones vary in colour from nearly white to fawn or deep reddish-brown; they are usually smooth on the surface, oval in shape, and compressed laterally. The density is moderate.

Urate of ammonium calculi are rare and usually occur in children in combination with the urates of lime and soda. They may be so like uric acid calculi that chemical analysis alone distinguishes them; but they are generally lighter, more porous, and are slightly nodulated on the surface. Sometimes the calculus resembles a piece of pipe-clay.

Chemical analysis.—Uric acid and urate of ammonium are both soluble in liquor potassæ, the warm solution of the latter giving off fumes of ammonia; the salts are re-precipitated on the addition of hydrochloric acid. Uric acid is slightly, and urate of ammonium freely soluble in boiling water.

Oxalate of lime calculi are formed in the kidney and are liable to occur in debilitated persons and those who partake largely of a vegetable diet rich in oxalates. The calculi may be quite small, smooth, and pale in colour, and in such cases are usually multiple; but the typical oxalate of lime or mulberry calculus is dark in colour, often dark brown or almost black from admixture with blood and organic matter; its surface is rough and tuberculated, and the stone is of great density and weight (Fig. 167).

By reason of their roughness oxalate calculi lead to severe symptoms, so that they are removed early, and hence do not usually attain a large size.

Chemical analysis.—Soluble in hydrochloric but not in acetic acid. Ignition gives rise to the formation of calcium carbonate which dissolves with effervescence in the presence of hydrochloric acid.

Phosphatic calculi form in the presence of decomposing alkaline urine. Phosphate of lime alone rarely forms a calculus, but in association with the ammonio-magnesian or triple phosphate it enters largely into the composition of most stones. The proportion in which these two salts are combined varies; two parts of the triple phosphate and one of phosphate of lime form the fusible calculus, which on ignition fuses into an enamel-like mass. Phosphatic calculi may attain a large size, are rounded or oval in shape, porous and loose in texture, and are readily broken up. In general appearance they are more or less chalky.

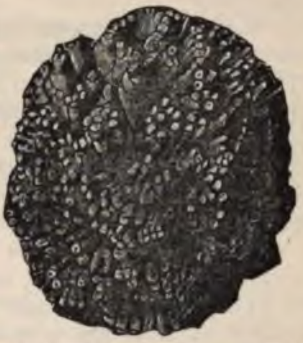

FIG. 167.—Urinary calculus composed of calcium oxalate and phosphate (Ziegler).

Chemical analysis.—Soluble in acid solutions, the solution giving a white precipitate of calcium oxalate in the presence of ammonium oxalate.

An acid solution of triple phosphate treated with excess of ammonia throws down triple phosphate crystals (Fig. 158, p. 497).

Cystine calculi are rare. They appear to be hereditary and are often met with in members of the same family. The calculi, which rarely attain a large size, are usually oval in shape and smooth on the surface; they are waxy in appearance and of a yellowish colour, but become green when exposed to the air. A fresh stone has a peculiar, soapy feel, and is said to emit a smell of garlic when rubbed. A cystine stone breaks with a crystalline fracture; the surface of section may be laminated but rarely is so. Cystine calculi are usually pure and contain 26 per cent of sulphur.

Xanthic oxide calculi are extremely rare. These are cinnamon coloured, firm in consistency though easily broken, and are laminated. Such calculi are capable of taking a wax-like polish.

Carbonate of lime calculi are of extreme rarity in man. They are chalky in appearance and are usually small and multiple. It is possible that they occasionally originate in the prostate and pass thence along the urethra into the bladder.

Mixed calculi.—Although uric acid, oxalate of lime, and the phosphates form by far the greater number of stones, yet it must not be supposed that any given calculus will be found composed of one or other of these substances exclusively; for in the vast majority of cases two or more enter into its composition, the different ingredients being arranged in laminæ (*alternating calculus*, Fig. 168).

General structure of calculi.—Vesical calculi are usually single, but numerous stones of small size are sometimes met with. The size of a stone varies within wide limits; instances of stones weighing several ounces are not uncommon, but when multiple they may be no larger than a pea. In cases of multiple calculi the individual stones are smoothly faceted and bear a striking resemblance to each other. The shape, colour, and consistency have already been referred to under the different calculi.

On section most calculi are distinctly laminated and consist of a central nucleus, a body, and an outer crust or shell.

The nucleus is usually composed of uric acid, less often of oxalate of lime, and is occasionally a foreign body. In the last case the calculus is of vesical origin and is formed of phosphates. Rarely the nucleus is at the side of the stone, and in such cases it is probable that the stone was at one time fixed in a sacculus, so that deposition only took place on one side. Occasionally the situation of the nucleus is represented by a cavity, the body of the stone having formed round a piece of mucus or clot which subsequently dried up.

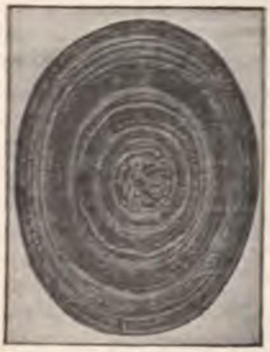
FIG. 168.—An "alternating" calculus (Ultzmann).

The body of the calculus is composed of concentric laminæ which may differ considerably in chemical composition, colour, and density, the difference in the chemical composition being dependent upon alterations in the urine and in the patient's health during the formation of the stone (*alternating calculus*, Fig. 168).

The crust or investing shell is almost always phosphatic and is deposited from the urine as the result of the cystitis which is excited.

The effects of vesical calculus.—A small calculus may be voided *per urethram*, but if not passed within a short time after its descent from the kidney it gradually increases in size and excites chronic cystitis and changes in the urine, which may lead to serious renal mischief. In the great majority of cases, calculi are quite loose in the bladder and usually lie near its neck, but it sometimes happens that when the bladder is sacculated a small stone falls into a sacculus and increases in size in this situation; it is then said to be **encysted.**

Spontaneous fracture sometimes occurs and is probably due to infiltration of the urine between the various laminæ of the stone through a fissure on its surface. It is very doubtful if, as has been asserted, the mere contraction of the bladder wall or the concussion of one stone against another can cause fracture.

Signs and symptoms.—Although the symptoms pointing to stone in the bladder are usually well marked and characteristic, yet in some cases (especially if the stone be encysted) they are so slight that its discovery by the sound comes almost as a surprise.

Frequency of micturition is excited by the irritation of the calculus and is consequently increased on movement, especially by riding, running, and the like; it is further aggravated by the existence of cystitis. Such frequency is specially noticed during the day, but at night when the patient is resting, it may cause little or no inconvenience unless cystitis be present. It is generally stated that there may be a sudden stoppage in the flow of urine, owing to the stone rolling opposite to and obstructing the neck of the bladder, but this symptom is of great rarity.

Hæmaturia varies considerably in amount; it may be absent from the first, or may diminish in quantity as the bladder becomes more tolerant of the presence of the stone. The hæmorrhage is rarely copious, except in the case of a rough oxalate stone or after violent exercise. The character of the hæmorrhage is described at p. 498.

Changes in the urine are present when the stone has excited cystitis (see p. 540).

Pain of an acute character is felt at the tip of the penis and neck of the bladder at the end of micturition, and is due to the contact of the stone with the highly sensitive and probably inflamed mucous membrane and with the vesical neck. If the stone is small or has been present some time and its surface be smooth, the pain may be trifling; sometimes it is very severe and is described by the patient as a "spasm." Children often pass the urine lying down, as this position to some extent prevents the sudden rolling of the stone against the neck of the bladder and hence diminishes pain; moreover, the irritation at the end of the penis makes them pull at the prepuce, so that inflammation and excoriation may result.

The subjects of vesical calculus frequently complain of a dull, constant, aching pain in the supra-pubic and perineal regions.

Subsidiary symptoms.—The constant straining and irritation about the bladder may occasion tenesmus, piles, prolapsus ani or priapism, but such symptoms are not frequently met with. Pain and anxiety, cystitis, and perhaps free hæmorrhage sooner or later produce impairment of the general health.

Secondary results.—Neglected cases of stone will exhibit all the changes in the bladder and kidneys which have been described on p. 507, but as at the present day early operation is performed, such results are rare.

Physical examination.—Large stones may sometimes be felt through the rectum or vagina, aided by pressure over the supra-pubic region, but in all cases the diagnosis must be confirmed by means of the sound. A good bladder-sound should have a short, curved beak, the direction of which must be indicated by a mark on the handle, so that its position in the bladder can always be ascertained; the sound should also be a catheter, so that the water may be drawn off or fluid thrown into the bladder at will.

Under ordinary circumstances an anæsthetic is not required, but this should always be given in cases of prostatic hypertrophy in which the discovery of the stone may be very difficult, and it is also advisable if the patient be nervous or the urethra and bladder unduly sensitive. The bladder should contain about two ounces of urine, or it may be emptied and that amount of boracic solution injected. The patient lies on his back with the head slightly raised, and a small pillow is placed beneath the buttocks so as to raise the pelvis in order that the stone may fall away from the neck of the bladder and be more easily reached. All manipulation must be carried out with great gentleness, not only to save the patient pain and avoid damage to the bladder, but because rough handling may create currents in the fluid which carry a small stone out of reach. When the sound is passed the stone may be immediately struck, conveying a characteristic sensation to the hand and giving out a ringing sound. Should this not occur the beak of the instrument is turned downwards to the floor of the bladder and held in that position for a few seconds so that the stone, if displaced during the passage of the instrument, may again fall to the bottom of the bladder. The sound, lightly held between the finger and thumb, is now gently rotated, first to one side, then to the other, drawn towards the neck of the bladder and pushed gently backwards, and if none of these movements discover the calculus the walls and roof of the bladder are systematically explored. Sometimes the stone lies behind the prostate and is with difficulty detected; in such cases, a finger in the rectum, combined with greater elevation of the buttocks, may enable the surgeon to strike it. Encysted calculus may easily escape detection, or the sound may strike that portion which presents at the mouth of the sacculus. The fact that the stone is encysted may be inferred if the instrument cannot be passed round it, and if it is always encountered in the same place (usually near one or other ureter) from which it cannot be dislodged. A coating of phosphates on a fasciculated bladder might possibly be mistaken for calculus, but in such cases the characteristic "ring" elicited by the sound is absent, no stone can be moved about in the bladder and the incrustation is usually widespread.

A stone may be missed (1) if the middle lobe of the prostate is enlarged; (2) if it is encysted; (3) if the bladder is empty and the folds of mucous membrane conceal it; and (4) if it is very small. If sounding with fluid in the bladder gives a negative result the fluid should be drawn off, and as it escapes the stone may be carried against the beak of the instrument. If no stone is found, but the evidence of its presence is strong, another opportunity must be taken to sound the bladder, and the cystoscope may be employed.

Diagnosis of the number, size, and density of calculi.—The presence of multiple stones or the approximate size of any individual calculus is usually easily determined by sounding. The density is indicated by the clearness of the note emitted on striking the calculus, and by a knowledge of the composition of the stone obtained from the state of the urine and general conditions.

Treatment.—Calculus in the bladder must be removed by lithotrity or lithotomy, according to the circumstances of the case. Multiple small calculi may be washed out without previous crushing, and in women stones of larger size may be removed through the dilated urethra.

Choice of operation.—Lithotrity is the preferable operation, but there may be circumstances which render the performance of lithotomy more advisable. Any stone which can be seized by the lithotrite may be crushed unless it is very hard (*e.g.* oxalate of lime), and such, even when small, may require lithotomy. Stones which, under favourable conditions, could easily be treated by lithotrity should usually be removed by lithotomy if the bladder is much inflamed and irritable, or if the patient is liable to urinary fever from the gentlest manipulation of the urethra. Renal disease is a complication of great gravity in all surgical procedures, but especially so in those practised on the urinary tract; in such cases the question between lithotrity and lithotomy can receive no dogmatic answer and must be decided after a careful review of all the circumstances of the case, but it may be stated in general terms that that operation should be selected which will entail the least shock and damage; if the surgeon is experienced in lithotrity, and if the stone be of moderate size and density, this operation may be performed, otherwise cutting is the wiser course; in all cases the performance of the operation should be postponed, if possible, until by rest and appropriate treatment the patient's condition has been improved to the utmost. Stricture offers no bar to lithotrity, for it must first be dilated. Enlarged prostate is not by any means incompatible with crushing, provided the stone can be readily found, and the obstruction is not sufficiently great to impede the ready introduction of instruments and their free manipulation, and that the kidneys are fairly healthy.

Encysted calculi must be removed by lithotomy. Until recently lateral lithotomy has always been employed in male children, but there is no objection to lithotrity, provided the instruments used are proportional to the size of the urethra and due care be exercised in their use.

Lastly, in drawing a comparison between lithotomy and lithotrity, it must be admitted that the former operation is more frequently fatal, but this can hardly be wondered at when we remember that the operation is usually only performed in bad cases, and doubtless this fatality will be still further diminished in the future. Recurrence of the calculus is more common after crushing on account of the fact that small fragments may be left which form a nucleus for a second stone. Recurrence is especially likely to occur in cases of enlarged prostate with chronic cystitis.

THE OPERATION OF LITHOTRITY

Preparation of the patient.—For a few days prior to the operation the patient should be kept at rest, the bowels acted on, and diuretics, such as the citrate of potash, may be given with advantage; a good, easily digestible diet should be allowed. If there is cystitis, the bladder must be washed out with boracic solution at least once a day so that it may be in as healthy a state as possible. The bowels should be opened by a purge the night before the operation, followed by an enema in the morning.

During the operation the patient should be warmly clad and protected from draughts, and in cold weather hot bottles should be applied to the trunk and lower extremities.

Operation.—The buttocks being well raised as in sounding for stone, the urine is drawn off and about two ounces of warm boracic solution injected into the bladder, this quantity being quite sufficient to distend it, so that the mucous membrane is not thrown into folds which might otherwise be caught up in the lithotrite and damaged. Every manipulation must be carried out with the greatest gentleness, so that no unnecessary damage is inflicted.

A fenestrated lithotrite, large and strong enough to deal with the stone, is carefully introduced (if necessary the meatus must be enlarged) and the stone is seized. This may usually be accomplished by turning the blades laterally, first to one side, and failing this, to the other, and as soon as the stone is felt the blades are carefully opened and closed on it; if this procedure fails, the lithotrite, with the beak looking upwards, should be depressed against the trigone, and the blades being opened the stone will almost certainly drop between them, especially if the instrument be lightly shaken. When the stone has been caught and the lithotrite locked, this should be gently moved to make certain that no mucous membrane has been entangled, an accident not likely to happen if the bladder contains two ounces of fluid. When the stone has been broken the large fragments are sought for and crushed; these are readily found if the lithotrite be kept in the same position as before, but if it is moved about in the bladder the fragments may be scattered and missed. Before withdrawing the instrument the blades are tightly closed. The evacuating tube is now introduced and the bladder emptied; a good deal of detritus is carried away by the rush of fluid. The evacuator is adjusted and about two or three ounces of fluid are thrown into the bladder at a time and the débris is thus washed out; any fragments which are too large to pass may be heard and felt to strike the evacuating tube with a characteristic click, especially if a stethoscope is applied over the pubes; these must of course be crushed. Sometimes a good-sized fragment impacts in the evacuating tube (indicated by the bottle failing to expand properly) and must be driven back by firm compression of the evacuator or by a stylet. When the operation is completed the bladder must be emptied.

Accidents and sequelæ.—Injury to the bladder, urethra, or an enlarged middle lobe of the prostate may be inflicted unless all manipulation is carried out with great care. Such damage may occasion considerable bleeding and the bladder may become distended with clot, which must be removed by the evacuator; very free bleeding during the early stages of the operation may be good ground for substituting lithotomy.

Cystitis is occasionally set up by the irritation caused by a retained fragment, and congestion of the prostate may also occur. Temporary atony of the bladder with retention is not uncommon, especially if cystitis has been excited or aggravated by the operation.

Urinary fever may ensue, especially in those who have a very irritable urethra and diseased kidneys; epididymitis is sometimes met with. If a fragment has been left behind it may escape into the urethra during micturition, and if too large to pass will become impacted, and must be removed as described on p. 344, vol. ii.

Lithotrity in women.—This operation offers no difficulty, and considerable fragments may be removed through the dilated urethra by means of small lithotomy forceps which will protect it against laceration.

Lithotrity in children requires the employment of specially slender instruments so that no damage is inflicted on the narrow and developing passages. The operation requires care and dexterity, and many surgeons prefer lateral or supra-pubic cystotomy.

Combined perineal cystotomy and lithotrity is now abandoned in favour of supra-pubic cystotomy.

After-treatment.—The patient, if his kidneys be in a fit condition, may have a small dose of morphia immediately after the operation, and if there is much spasm or tenderness hot fomentations should be applied to the bladder and perineum. Spasm may be relieved by a suppository of belladonna, gr. 1, camphor, gr. 3; conium and hyoscyamus are sometimes useful. Complete rest should be enjoined for five days or more according to the severity of the case, and during this time it is well to gently wash out the bladder daily through a large-eyed catheter. The food should be chiefly fluid, and plenty of barley water and mild diuretic drinks should be given. The bowels should be opened on the second day and kept acting regularly. Before the patient is lost sight of, his bladder should be carefully sounded to ascertain if any fragment remains behind, and if this is found to be the case it must be removed. Complications must be treated according to their nature.

LITHOTOMY

The lateral operation of lithotomy is now superseded by the supra-pubic method, but the former is preferred by some in the case of children. The **supra-pubic** route gives freer access to the bladder, and is not so dangerous if due care be taken. The details of the operation are described below.

The median and vesico-vaginal operations should not be performed; the former gives but little room, and may be, though rarely is, attended by smart hæmorrhage. Vesico-vaginal cystotomy may result in permanent fistula and has nothing to recommend it.

SUPRA-PUBIC CYSTOTOMY

Supra-pubic cystotomy may be required for the removal of stones, foreign bodies, or tumours of the bladder, for the performance of prostatectomy, or to give drainage in cases of intractable cystitis and retention. I have successfully employed it in a case of stricture with extensive perineal abscess, in which I repeatedly failed to pass an instrument into the bladder; the supra-pubic opening enabled me to pass the catheter from the bladder to the perineal wound, and thence along the penile urethra.

Preparation of the patient.—The same as for lithotrity (see p. 554), with the addition that the pubes should be shaved and thoroughly cleaned.

Operation.—When the patient has been anæsthetised the rectal bag is introduced by an assistant, and is distended with air or water sufficiently to push the bladder well up, but not to too great an extent, or the mucous membrane of the rectum may be torn.

The bladder is washed out, and when the fluid comes away clear it is distended (in the adult) with about ten or twelve ounces of fluid; too great distension may cause rupture, especially if a sacculus be present. As the bladder is filled it rises well above the pubes, and the peritoneum is carried upwards out of danger; the surgeon supervises this with his hand, and when the summit of the bladder has risen well above the pubes no more fluid need be injected. The abdominal wall is incised in the middle line, the incision being begun about three inches above the pubes and extending to it (Fig. 19, *e*, p. 84). The linea alba and fascia transversalis are carefully divided and the fat round the bladder is exposed; many veins, often large and congested, will be seen. If the peritoneum is seen bulging into the upper angle of the wound during inspiration, it should be gently pushed upwards and protected by a narrow retractor. The cellular tissue is carefully torn through with two pairs of forceps, every care being taken not to damage the veins, and that the separation of the tissues is only conducted in the line of the incision, so that the dissection is not carried down by the side of the bladder; the peri-vesical cellular tissue is thus disturbed as little as possible, and the danger of urinary infiltration and consecutive cellulitis is thereby avoided.

The pink muscular coat of the bladder is easily recognised, and when this is exposed a silk thread is passed through the bladder wall on each side to act as a guide, and a small vertical incision is made at the highest point exposed. If it be made close to the pubes, the opening will sink down behind this out of sight as the fluid escapes and the viscus collapses. The opening may be enlarged to the required extent by the fingers.

If a stone is present it may readily be removed by the two index fingers or lithotomy forceps.

Prostatectomy is easily effected by division of the mucous membrane, and enucleation of the middle lobe with the finger (see p. 571).

Tumours are torn away with specially constructed toothed forceps (see p. 546).

When the operation has been completed the rectal bag is emptied and withdrawn, and this tends to materially diminish any bleeding which may be going on. A drainage tube is introduced into the bladder and must be retained for a varying time according to circumstances. In the case of lithotomy, twenty-four hours is long enough, unless there is severe cystitis which may be much benefited by longer drainage. In tumour cases the tube should be retained until all blood and clots have come away. Although the ideal operation would consist in suturing the bladder wall and closing the external wound, experience shows that this is unwise, and that the wounds should be left to granulate. The rapidity of healing varies much; the wound may be soundly healed in three weeks or less, or may remain open a much longer time.

After-treatment.—The skin round the wound must be covered with vaseline to prevent irritation by the continual flow of urine, and the wound should be dusted with iodoform and kept clean by frequent irrigation, or a soft catheter may be passed by the urethra night and morning, through which the bladder can be thoroughly flushed. The wound should be covered with a layer of gauze on which a gauze bag filled with coarsely carded moss-peat should be placed. This is an admirable absorbent, and should be changed frequently. The day after the operation the patient should lie on his back and on either side alternately, so that free drainage is obtained.

Dangers of the operation—**Hæmorrhage** may be severe and troublesome if the veins running in the cellular tissue in front of the bladder are wounded. They should be avoided by gently tearing the cellular tissues with forceps, or scratching through it with a blunt instrument.

Wound of the peritoneum may occur if the incision is made too high up or the bladder not sufficiently distended. It is wiser under such circumstances to close the wound in the peritoneum and abandon the operation for two or three days, the external wound being plugged with gauze. If the immediate completion of the operation is urgently called for, the peritoneum must be closed as securely as possible by suturing, and a plug of gauze placed in the wound at the upper part; the operation is then completed, and the bladder must be very freely drained and every care taken to prevent septic peritonitis.

Extravasation and cellulitis is a very rare occurrence. It is easily prevented by avoiding too free separation of the cellular tissue at the time of the operation, and by frequently changing the patient's position afterwards. The use of the tube for the first few days prevents the occurrence of cellulitis.

Shock.—The shock is very slight, but in old men with diseased kidneys the operation may prove fatal.

Supra-pubic cystotomy in women.—Owing to the difficulty of maintaining full distension of the bladder, it is sometimes necessary to introduce a steel sound in order to push the viscus well up above the pubes. Special care should be taken to avoid wounding the peritoneum. A bag may be placed in the vagina, and being fully distended, will push up the bladder; in virgins the bag should be used in the rectum.

CHAPTER XXV

DISEASES OF THE PROSTATE

Anatomy.—The prostate surrounds the neck of the bladder and encloses the prostatic urethra which runs nearer the anterior than the posterior limit of the gland. It is about the size of a large chestnut measuring one and a quarter inch from before back, one and a half inch laterally, and one inch in thickness; it weighs about an ounce.

The prostate lies upon the rectum between the levatores ani muscles, and is enclosed in a double layer of the recto-vesical fascia, between which lies the prostate plexus of veins. It consists of two lateral lobes and a much smaller third or middle lobe which projects towards the bladder and corresponds to the eminence in it known as the uvula. The apex of the gland lies behind the triangular ligament, the base surrounds the neck of the bladder, and at this spot is a notch where the ejaculatory seminal ducts come into relation with the gland.

The prostate is principally composed of involuntary muscle with some glandular, fibrous, and elastic tissue. The glandular substance is composed of acini and ducts lined by columnar epithelium; the ducts, twelve to twenty in number, open into the urethra by the side of the verumontanum.

ACUTE PROSTATITIS—PROSTATIC ABSCESS

Etiology.—Acute inflammation of the prostate is usually due to gonorrhœa. It may also arise, especially if the organ be enlarged, from exposure to cold, the irritation caused by the passage of instruments along the urethra, or from any other cause of local irritation.

Morbid anatomy.—When due to gonorrhœal infection the inflammation begins in and may remain limited to the ducts (*follicular form*), or it may spread to the general substance of the gland (*parenchymatous*), or to the surrounding cellular tissue (*peri-prostatitis*). The gland is congested, swollen, and somewhat enlarged, but resolution usually occurs without subsequent trouble; in other cases the inflammation becomes chronic and the prostate remains slightly enlarged. Suppuration is not uncommon, and as the abscess increases in size, either by direct extension or by the coalescence of adjacent foci of suppuration, the gland may be completely destroyed, and the abscess continue to discharge for a long time. Prostatic abscess usually bursts into the prostatic urethra, but may do so into the rectum; more rarely the pus finds its way to the perineum. Suppuration in the cellular tissue leads to the formation of a large abscess which burrows along the bowel.

Symptoms.—There will be a history of antecedent gonorrhœa, or a urethral discharge may be actually present, though this has usually temporarily ceased with the onset of prostatitis. The patient complains of great irritability about the neck of the bladder, with frequent and urgent desire to micturate, although he only voids a few drops with great pain of a spasmodic nature, which is referred to the neck of the bladder and is transient in duration (*strangury*). There may be complete retention from occlusion of the urethral canal by the swollen prostate. There is a sense of weight or fulness in the perineum, aggravated by pressure and by defæcation; the pain radiates to the back, the loins, and down the thighs, and may be felt in the supra-pubic region. Rectal examination (which causes considerable pain) reveals the fact that the gland is enlarged and very tender, and if suppuration has occurred, a softened boggy area may be detected, pressure on which may cause a discharge of pus from the urethra if the abscess has already burst in that direction. There is usually some constitutional disturbance with slight fever, general malaise, and often marked mental depression; when suppuration occurs the general symptoms are much aggravated, and the patient may have repeated shivering fits. Owing to the depth of the gland from the surface the presence of suppuration can rarely be made out by examination of the perineum.

Treatment.—Considerable relief follows the local employment of heat. The patient should be frequently allowed to sit in a hot hip bath, and in the intervals a sponge wrung out of hot water should be applied to the perineum; hot water enemata are also very soothing. If the pain is great a few leeches should be applied to the perineum, and morphia and belladonna suppositories prescribed. Retention of urine calls for the passage of a catheter, a flexible rubber instrument being the best. The bowels should be emptied by enemata and kept acting by the use of salines.

As soon as suppuration is present, no time must be lost in opening the abscess by an incision through the centre of the perineum, one finger being placed in the rectum as a guide. The pus which escapes may be mixed with urine. If the abscess bursts spontaneously into the urethra, or if it has been ruptured by the passage of a catheter for the relief of retention, the surgeon should wait a few days to see if it will close, but if the symptoms show that this is not occurring (on account of the small opening and consequent imperfect drainage), he should at once lay the abscess open as above described. The abscess cavity must be kept clean, and will readily heal from the bottom.

CHRONIC PROSTATITIS

Chronic prostatitis is a not uncommon sequel of the acute form, or of a persistent gonorrhœa. The gland is slightly enlarged and indurated, and the secretion is increased in quantity. The prostatic urethra usually participates in the inflammation.

Symptoms.—There is frequency of micturition, with some pain at the end of the penis, and a constant sense of weight and heaviness in the perineum, accompanied by tenderness. A muco-purulent discharge from the urethra is usually noticed, especially in the morning, and this, as well as the other symptoms, is often aggravated by exercise, by coitus, or by indulgence at the table. Sometimes the discharge from the urethra is copious, clear, and glairy (*prostatorrhœa*). The urine is often turbid, and contains shreds and thread-like masses of secretion from the prostatic ducts. Constipation is usually present, and the patient may be troubled with nocturnal emissions which frequently cause pain. On rectal examination the gland will be found slightly enlarged, hard, and tender. The sound eliminates the presence of vesical calculus, the symptoms of which are very similar. A very distressing mental state is by no means an uncommon accompaniment of chronic prostatitis; the patient becomes very despondent, sometimes almost melancholic, and is quite unable to go on with his work or turn his thoughts from his malady, the gravity of which he much exaggerates. Chronic suppuration sometimes ensues, and the pus may gradually burrow between the rectum and prostate.

Treatment.—It is of great importance to reassure the patient as to the really trivial nature of his complaint. Sexual connection, horse-riding, and violent exercise should be avoided, and sparkling wines, or irritating articles of diet must be prohibited. Cold douching and the injection of cold water *per rectum* are sometimes beneficial, and may be used night and morning. Blistering the perineum with liq. epispasticus often gives excellent results; the blistering should be repeated about every fifth day as long as local relief is obtained. If the urethra is specially involved, it may be treated with a solution of nitrate of silver, either through the endoscopic tube, or by means of Guyon's injector; at first ·5 grs. ad ℥i. is sufficiently strong, but this may gradually be increased to twenty grains; if the application causes much pain, a little cocaine (10 per cent solution) should be first injected. Good food and tonics should be given, and change of air is much to be desired in obstinate cases, especially if there is much mental depression.

PROSTATORRHŒA

A discharge of clear glairy fluid from the prostatic ducts may follow micturition or straining at stool; the fluid is merely an increase of the normal secretion, and does not contain spermatozoa. This condition is due to chronic prostatitis, or undue sexual excitement. It probably does no harm, but unfortunately the patient is often unduly anxious about his condition, thinking he has spermatorrhœa, an idea which advertising quacks will zealously foster should he foolishly consult them.

Treatment consists in remedying the chronic congestion by the means employed for chronic prostatitis, and giving the patient plenty of exercise and work to draw his mind from the subject. Blistering often does much good. Belladonna is recommended by some surgeons. The bowels should be kept freely acting, as when they are loaded the prostate is congested and the secretion increased.

TUBERCULAR PROSTATITIS

Morbid anatomy.—Primary tubercular disease of the prostate is a rare condition, but its involvement in cases of tubercular epididymitis, or general tubercle of the genito-urinary tract or lungs is not uncommon. It is said that a persistent prostatic gleet may occasion primary disease in patients of a tubercular diathesis. The gland is studded with tubercular foci which, by coalescence, may occupy and destroy a considerable portion of it. As the caseous areas soften and break down a chronic abscess results, which may burst into the urethra or more rarely into the rectum or on the perineum. The prostate is enlarged, but often irregularly so. The disease spreads to the vesiculæ seminales, periprostatic connective tissue and bladder. In most cases the patient dies from the effects of pulmonary or renal tuberculosis before the stage of prostatic abscess is reached.

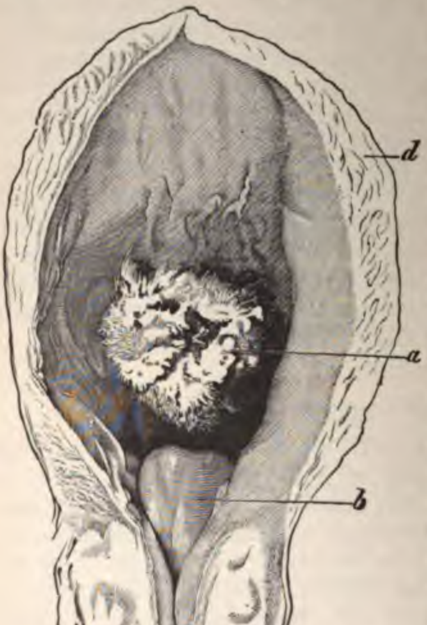

FIG. 169.—Papillomatous growth of the bladder with hypertrophy of the prostate (Ziegler) *a*, new growth; *b*, *c*, enlarged prostate; *d*, thickened and inflamed bladder walls.

Signs. — Tubercular prostatitis occasions symptoms of vesical irritation similar to those met with in chronic prostatitis of non-tubercular origin; chronic cystitis from an extension of the disease is common. If abscess forms and bursts into the urethra, the occurrence will be marked by discharge from the tube, and it may be possible to detect the bacillus in the pus.

On rectal examination the gland will be found to be enlarged, often in one part more than another from the unequal distribution of the tubercle. The vesiculæ may also be implicated.

Treatment.—The general treatment of tubercle must be enforced, but no local means can be employed beyond giving free escape for the matter should suppuration occur. Sharp-spooning has been employed, but in view of the fact that the disease is not limited to the prostate, it is of doubtful utility.

SENILE ENLARGEMENT OF THE PROSTATE

Etiology.—Apart from the fact that it does not occur before the age of fifty-five, we know practically nothing as to the etiology of this troublesome affection. It is believed by some that it is dependent upon great sexual vigour and indulgence, and it is suggested that its occurrence after the period of full sexual activity is due to the fact that the prostatic energy—so to speak—is expended in growth rather than function.

Morbid anatomy.—The enlargement is due to an overgrowth of all the elements forming the normal prostate, but differs from hypertrophy in that it serves no useful purpose in the economy. The muscular, fibrous, and glandular elements are not increased in equal degree, the two first being especially prominent. The whole gland may be enlarged (Fig. 169), but the enlargement usually affects one part more than another, and a definite tumour may be present (*prostatic adenoma*, Fig. 170).

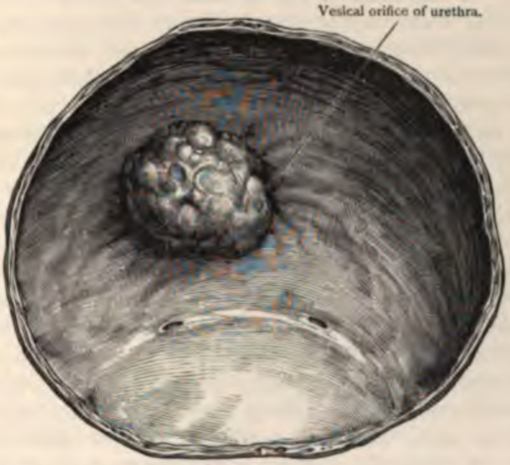

FIG. 170.—Median prostatic adenoma from a man sixty years of age Sketched from within the bladder (Bland Sutton).

The gland is more dense than natural, and the ducts may be dilated into small cysts which may contain concretions composed of organic and earthy material. Prostatic enlargement leads to certain changes in the urethra and vesical outlet, on which the symptoms are dependent. The canal is elongated from before back and narrowed from side to side by enlargement of the lateral lobes, but if one of these be larger than the other the canal is deflected to the less enlarged side; these changes do not, however, offer much, if any, impediment to the free escape of urine. When the middle lobe is enlarged it forms a more or less decided prominence in the trigonum vesicæ, and projecting upwards immediately behind the orifice of the urethra obstructs the free flow of urine. The middle lobe may form a broadly sessile tumour in the bladder, which not only prevents the free flow of urine but offers an impediment to the entrance of a catheter (Fig. 170, p. 565). The orifice of the neck of the bladder and the urethral canal are crescentic, the concavity corresponding to that part of the gland which is chiefly enlarged; thus when the middle lobe is affected the concavity of the vesical orifice looks downwards, and the urine passes on each side of the lobe.

When the enlargement is so situated that the passage of the urine is impeded certain secondary changes occur in the bladder, and, in bad cases, in the ureters and kidneys. As the bladder is not completely emptied it becomes pouched behind the middle lobe, and this pouch retains urine which no effort on the part of the patient can void, since muscular contraction tends to further obstruct the vesical outlet by forcing the enlarged lobe against it. Sacculi may also form, especially near the ureters. The retained urine may become putrid, and acute or chronic cystitis results; in the latter case the large quantity of mucus which is present in the viscus offers a further difficulty in micturition. Over-distension soon leads to atony which, in turn, adds to the difficulty. These changes may extend backwards along the ureters which may be considerably dilated; the kidneys are often the seat of chronic inflammation which constitutes a serious danger.

Calculi, mainly composed of phosphates, are very liable to form as the result of chronic cystitis, a condition which their presence aggravates.

Symptoms.—The situation of the enlargement is the important factor in the production of symptoms; the lateral lobes may be considerably increased in size without occasioning much or indeed any difficulty in micturition, whereas even slight enlargement of the middle lobe, which projects up into the floor of the bladder and obstructs its outlet, may cause urgent symptoms.

The symptoms are dependent upon the impediment to the flow of urine, and upon the complications (*e.g.* cystitis) excited by such impediment.

Impediment to the flow of urine.—The patient frequently complains that he passes too much urine, or that he suffers from "incontinence." This explanation seems to him quite logical from the fact of his having to pass his urine more frequently than usual, especially at night. On inquiry it will be found that the amount of urine he passes at any one time is very small, that it comes away with some difficulty in a small, forceless stream, which is perhaps quite arrested if the patient attempts to increase its volume or the rapidity of its flow by muscular effort. The reason of the increased frequency becomes clear when the anatomy of enlarged prostate is remembered. The bladder is pouched behind the obstruction, and in order to empty this pouch a muscular effort is necessary, but this increases the difficulty by pushing the middle lobe over the vesical orifice, and effectually closing it. It consequently follows that as the patient never empties his bladder, although from its dilated condition its capacity is actually increased, yet potentially the capacity is represented only by that quantity of urine which the patient can voluntarily pass when the bladder is full, and as soon as the kidneys have secreted that amount the call to micturate becomes imperative. Thus supposing the actual capacity to be thirty ounces, and the patient has twenty-five ounces of residual urine, he is compelled to micturate when the kidneys have secreted five ounces. How frequently this occurs varies according to circumstances; if the amount of urine which the patient is unable to pass voluntarily (*residual urine*) is small, the frequency of micturition is not very troublesome, but in the worst cases (especially if cystitis or calculus be present) it may be that the patient is compelled to pass water every quarter of an hour, or it may perpetually dribble away. The increased frequency at night is probably due to renal congestion and the consequent more rapid secretion of urine.

There is a time, during the early stages of the trouble, at which there is no pouching of the bladder behind the prostate, and the frequency of micturition during this period is probably due to the irritation at the vesical orifice caused by the presence of the enlarged third lobe; the irritation may also be caused or much increased by the presence of a calculus or chronic cystitis.

Complications consequent on the obstruction may lead to additional and very serious symptoms. The residual urine may become putrid, especially if a dirty catheter has been passed and cystitis thus set up; but the secretion may be perfectly healthy and normal in appearance, provided no renal changes are present.

Acute congestion of the prostate may follow exposure to cold and damp, over-indulgence at the table, or sexual excess. The consequent swelling of the gland will materially increase the patient's troubles, and may lead to acute retention of urine, which may, especially if the bladder or kidneys be affected, lead to very grave symptoms. The call to micturate is very urgent, and the act is accompanied by considerable pain, and perhaps hæmorrhage.

Calculus formation similarly leads to increased trouble, with pain, hæmorrhage, cystitis, and the usual signs of a foreign body in the bladder.

Renal complications add much to the gravity of the case.

Constipation and *piles* with prolapse of the rectal mucous membrane are common. The victims of enlarged prostate are occasionally very erotic, their sexual passions being exhibited by perverted and sometimes criminal acts.

The condition of the general health depends in the main upon the presence or absence of secondary complications, pain, or hæmorrhage, and upon the frequency of the call to micturate. If the night's rest is disturbed, the general health soon suffers in a marked degree.

Diagnosis.—The enlargement of the prostate may usually be diagnosed by rectal examination; but the mere fact that the gland be found enlarged does not necessarily mean that it is productive of symptoms, for, as already shown, mere enlargement is by no means so important as is its position. Rectal examination may not reveal the enlargement of the middle lobe even when this is producing the most troublesome symptoms, so that other means must be adopted to arrive at an accurate diagnosis as to the condition. After the facts as regards symptoms have been ascertained, the patient should be directed to pass water. If he is observed during this, it will be noticed that he slightly bends forwards the body, avoids all strain, and waits for some seconds before any urine escapes; when it does so, the flow is small, forceless, and may pulsate with respiration. The urine can hardly be said to be expelled, it rather dribbles away especially if there is associated atony of the bladder, consequently the time occupied in micturition is long. When, as he thinks, the patient has emptied his bladder, the surgeon should propose the passage of a catheter[1]—a proposal often at first rejected by the patient, on the ground that there cannot be any urine left in the bladder, since he passes it so frequently. He has not consulted you to have water drawn off, but to have the "incontinence" cured. An explanation of the facts, and the assurance that the passage of the instrument will be painless and less harmful than neglect of the condition, will usually overcome his scruples. The amount of residual urine may be any quantity from an ounce or two to as many pints. The patient is usually much surprised that there is any. He may be assured that he will not again require to pass water for some hours, the time depending upon the amount of residual urine drawn off. This statement he will probably receive with incredulity, but to his satisfaction will find it to be true. If, before the catheter is passed, the surgeon percusses the abdomen, he may find that the bladder is considerably distended with residual urine. If the amount be large, the bladder should not be emptied, since so doing may cause fainting, which has been known to be fatal. As soon as the diagnosis is made, the nature of the case should be explained to the patient, and the object and necessity for treatment pointed out.

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[1] Whenever possible, this should be done at the patient's own home, since it is impossible to predict what may be the effect of instrumentation (see Urinary Fever, p. 508).

Treatment.—The treatment of simple uncomplicated cases consists in the complete withdrawal of all residual urine by the catheter, and the prevention of cystitis and congestion of the gland. The question as to how frequently the use of the catheter is required must be settled by a careful estimate of the amount of residual urine; if this is below three ounces, the instrument is not needed more than once a day, and should preferably be used the last thing at night, so that the patient is ensured some hours of complete rest and is not wakened by the call to micturate. When the residual urine is as much as six ounces, the catheter should be passed night and morning, and if the quantity is greater, the instrument will be required more frequently. In bad cases it is necessary every hour, or even less; under such circumstances additional treatment becomes necessary.

Before resorting to habitual catheterism by the patient, the following plan should be adopted:—Supposing the case of a patient whose residual urine amounts to a pint or more, he should be confined to the house, or to one room, and should remain in an equable temperature. The action of the bowels and skin must be regulated, and the diet must be generous but unstimulating. The surgeon should himself pass the catheter, drawing off more and more urine at each operation until the bladder is emptied. The number of times the catheter is required daily must depend upon the circumstances of the case, the relief afforded, and the frequency of the call to micturate as above indicated. The patient must now be instructed to pass the catheter for himself, and must be given stringent directions for keeping his instruments clean.

Provided no untoward symptoms make their appearance during the early days of treatment, the patient may, at the end of about ten days, resume his ordinary manner of life; but should the catheterism have excited so-called "urinary fever," his confinement to the house must be more prolonged.

Choice of a catheter.—The same shape and make of catheter is not equally suitable for all cases, experience soon teaching which passes most readily. If at first the passage of the instrument causes pain and urethral irritation, it is best to pass very gently and slowly a well-oiled india-rubber instrument which can be sterilised immediately before and after use by boiling. The rubber instrument is, owing to its want of rigidity, sometimes difficult to pass, and if the obstruction at the neck of the bladder is marked, its onward progress may be arrested.

The coudé catheter usually passes very readily, the end beyond the elbow easily surmounting the middle lobe or passing to one side of it.

Perhaps the easiest to pass of all is an ordinary English catheter (made of the best silk and having a well-polished surface) which has been mounted on a stiff stylet and curved so as to resemble a note of interrogation. This shape must have been maintained for a few days before the instrument is used. Before use the stylet is withdrawn and the curve straightened out; this tends to re-form at once and consequently the beak of the catheter keeps along the roof of the urethra, and easily passes by the enlarged middle lobe, provided the instrument be introduced with the terminal curve towards the dorsal aspect of the penis. Metal instruments are rarely used. Whatever form of catheter is used should be about twelve inches long, since the prostatic urethra is elongated, and if the bladder is much pouched it will be necessary to make the instrument reach the floor.

Cleansing the catheter.—The importance of thorough cleanliness cannot be over-estimated; from a neglect of this obvious sanitary precaution many a man has excited acute cystitis with secondary renal mischief, too often with a fatal termination.

Catheters should be kept in a tin box or long glass bottle similar to those used for tooth-brushes, which can be readily cleaned, and those which have been used should always be kept separate from the new ones, of which the patient should always carry at least one.

As soon as the surface of a catheter gets rough or cracked, it should be burned. India-rubber and metal instruments are readily cleaned by boiling. Gum-elastic, silk, and linen catheters must be cleaned before and after use by thoroughly rinsing them in a solution of boracic acid, grs. 4 ad ℥i., some of which is syringed through the lumen by a wash-bottle. Mercury solution may also be used. After cleaning, the catheter should be carefully dried, but if it has to be used frequently it is best kept immersed in boracic-solution.

Operative treatment of enlarged prostate—*Supra-pubic or perineal drainage* may be necessary in cases complicated by intractable cystitis, in obstinate retention, and when the vesical irritation is so great that very frequent recourse to the catheter is necessary, involving continual pain, perhaps bleeding, and interfering with the patient's sleep. Drainage by a median perineal incision, which may be kept open as long as necessary, is often employed.

Supra-pubic prostatectomy.—In cases where the middle lobe is much enlarged and causing considerable obstruction necessitating the frequent use of the catheter, and in which the general condition of the patient and the state of his kidneys is good, the surgeon may afford relief by removal of the offending middle lobe. The steps of the operation of cystotomy are described on p. 557. When the bladder is opened, its cavity should be searched for any calculus which may possibly be present. The middle lobe is quite easily enucleated by the finger. The bleeding may be smart, but is easily arrested by iced water or ice. After the operation, the bladder should be drained for two or three days.

Perineal prostatectomy has been advocated by some. Perineal cystotomy is performed and the middle lobe divided and enucleated by the finger. The operation is inferior to that just described, and is more dangerous.

Castration.—This operation was introduced by White of Philadelphia, and has been repeatedly performed. Soon after the removal of the testicles the prostate becomes much smaller, and the patient to a certain extent regains the power of passing water naturally, and may dispense with the frequent use of the catheter. Gradual improvement may continue for weeks after the operation. Removal of one testicle produces atrophy of the prostate on the same side, and a certain amelioration of the symptoms. It is necessary, however, to use discrimination in the selection of suitable cases. In patients who suffer but little inconvenience beyond the occasional passage of the catheter the operation should not be performed—perhaps a needless caution, since no patient would submit.

It occasionally happens that acute temporary mania supervenes on castration in these cases.

Vasectomy.—Some surgeons have recommended the division or removal of a piece of the vas deferens as being a less serious proceeding than castration, and practically attaining the same end, although taking a longer time so to do. The atrophy does not, however, appear to be so complete.

Cases suitable for castration or vasectomy.—With extended experience of these operations from his own practice and that of other surgeons White comes to the following conclusions as regards the advisability of performing one or the other in any given case. Vasectomy should be given the preference :—

(1) If the patient is old, his sexual power practically nil, and the urine is foul with frequent and painful micturition, and especially if the kidneys are diseased.

(2) If the residual urine amounts to twelve ounces and is not diminished by catheterism, pointing to atony of the bladder, with the possible occurrence of cystitis or renal mischief.

(3) If there is great pain which mild sedatives do not abolish.

As regards castration it should be selected in cases in which the renal function is not markedly inadequate, but in which pain, frequent micturition, or cystitis demand some radical treatment. In such cases, however, prostatectomy may be performed, provided the patient is not very advanced in years.

In aged patients with chronic cystitis and renal disease operation should not be performed unless the condition urgently demands it, and in such a case vasectomy is perhaps the wisest course. But all operations, in view of the renal imperfection, are fraught with much danger. These cases are often very much benefited by drainage.

General treatment is directed to the prevention of cystitis, congestion of the prostate and retention, and secondary complications. The patient should be advised to clothe himself warmly and avoid cold. He should be indoors by sundown, and during wet weather as much as possible. He should not sit out of doors, except in warm, mild weather. The bowels must be regulated, and he should be warned of the possible danger of acute congestion of the prostate with retention from free living or sexual excitement.

The treatment of secondary complications—**Retention with enlarged prostate** may result from exposure to cold or any cause producing congestion of the pelvic viscera. It is due to temporary swelling of the organ and closure of the urethra. An attempt must be made to pass a small (No. 6) soft catheter. This should be done very gently and slowly, as it often causes considerable pain and excites spasm of the bladder and perineal muscles. It may cause a good deal of bleeding, which need not cause alarm, for the loss of blood often acts beneficially by relieving the congested vessels. If there is much difficulty in passing the instrument it should be tied in and a careful watch kept on the patient in view of the possible occurrence of reflex kidney mischief. Should this occur the instrument must be withdrawn and passed two or three times a day as occasion requires. If all attempts at catheterisation fail the bladder must be aspirated above the pubes. The bowels should be freely opened and the patient placed in a hot hip bath for from ten to fifteen minutes at a time, the sitting being repeated two or three times a day, provided the patient can stand it. Belladonna suppositories are very beneficial. In the worst cases it may be necessary to drain the bladder by a supra-pubic or perineal opening.

Cystitis.—Every care must be taken to avoid the occurrence of cystitis by scrupulous cleanliness. If it occurs the bladder must be washed out with boracic acid and the treatment described on p. 541 adopted. Intractable cystitis may require drainage of the bladder.

Calculus not infrequently forms in connection with enlarged prostate, and the difficulty of finding the stone is sometimes great. Under ordinary circumstances lithotrity can be performed, but calculi frequently re-form. If lithotrity is impossible owing to the obstruction at the neck of the bladder, or other causes, the stones must be removed by supra-pubic cystotomy, and at the same time the middle lobe of the gland may be removed if the condition of the patient warrants the operation. No operation for calculus should be performed until the patient has been kept at rest for some days, during which time the bladder must be washed out and the cystitis treated. The operation must not be performed unless the kidneys are found to be excreting a sufficient daily quantity of urea (see pp. 496, 525).

INNOCENT TUMOURS OF THE PROSTATE

Localised enlargement of the prostate is sometimes caused by the growth of an adeno-fibroma, similar in general structure to the ordinary enlarged prostate. These tumours are analogous to the fibro-myomata of the uterus. They may be embedded in the substance of the gland or project from its surface, in which case they may become pedunculated.

The symptoms are those of senile enlargement, their occurrence depending upon the precise situation of the growth, and treatment is conducted on the same lines. These tumours are easily shelled out through a median or lateral incision, and have frequently been removed during lithotomy.

Cysts occasionally arise by dilatation of the acini or ducts especially in cases of calculus. Their existence is of pathological interest only.

MALIGNANT DISEASE OF THE PROSTATE

Primary glandular cancer of the prostate is a rare condition. It may occur in children, or after forty-five years of age. The growth begins by proliferation of the glandular epithelium, which passes beyond the walls of the acini and infiltrates the substance of the gland. The prostate is enlarged and hard, but as softening occurs from degeneration the consistency may vary in different parts. The growth gradually extends to the surrounding cellular tissue, to the bladder, the rectum, and urethra, and secondary deposits occur in the lumbar glands. Cancer originating in the bladder or rectum may secondarily involve the prostate, and spindle-celled sarcoma has been met with as a primary growth.

Signs.—The signs are similar to those of enlargement of the prostate, with certain additional diagnostic features. The disease occurs at an earlier period of life than senile enlargement, the prostate enlarges more rapidly and the outline is not so clearly marked. There is considerable pain, especially when the urethra is encroached upon and the impediment to the escape of urine increases. Bleeding is often profuse. The blood may pass into the bladder and be voided with the urine, or may escape from the urethra independently of micturition. If the growth spreads to the bladder or urethra particles of it may be detected in the urine, and cystitis is excited. As the prostate increases in size it more or less fills the pelvis and produces pressure on the rectum.

The patient loses health and strength, and finally succumbs from exhaustion or chronic cystitis and secondary renal mischief.

Treatment is palliative only, and has reference to the withdrawal of the urine when there is evident impediment to the flow. The catheter should not be used unnecessarily, as it only excites pain, irritation, and bleeding.

In bad cases supra-pubic cystotomy and drainage may be the only means of relief.

CALCULI IN THE PROSTATE

Formation and composition.—In advancing age minute solid particles are fairly constantly present in the prostatic ducts. They may be pale in colour or dark reddish-brown, and are often not unlike the seeds of a dried fig. Similar bodies are occasionally found in the vesiculæ seminales. They are composed of organic matter from inspissated secretion, and in many cases, perhaps in all, form the nuclei of prostatic calculi. The calculi are chiefly composed of phosphate of lime precipitated from the prostatic mucus, which, owing to the irritation caused by the presence of the before-mentioned bodies, is increased in amount. A small quantity of carbonate of lime is also present, and about 15 per cent of organic matter. They are pale fawn colour, or somewhat darker, are usually smooth on the surface, and when many stones are present they are faceted. The stones lie in the ducts, which are distended into small cysts. Sometimes the stones are of considerable size, and may lie in a large cavity surrounded by condensed prostatic tissue.

Signs.—Prostatic calculi, unless large or numerous, rarely give rise to symptoms. The symptoms are chiefly those of irritation at the neck of the bladder or of calculus in that viscus. There may be some hæmaturia, or blood may escape from the urethra independently of micturition. Examination by the rectum may reveal the presence of the stones, or they may sometimes be felt by passing a steel sound along the urethra. The constant presence of the stone in one position, inability to move it, and the fact that the grating is felt before the bladder is reached, are indicative of the prostatic situation of the calculus. Acute inflammation and suppuration are sometimes excited, and the stones are discovered when the pus is evacuated.

Treatment.—Prostatic calculi can be readily removed by a median incision in the perineum.

CHAPTER XXVI

DISEASES OF THE URETHRA

Anatomy.—The **male urethra** consists of prostatic (one and a quarter inch), membranous (three-quarters of an inch), and penile (six inches) portions. The first is the widest and the second the narrowest portion, if the meatus be excluded. The penile urethra is freely movable, the prostatic much less so, and the membranous is practically fixed owing to its relations to the triangular ligament. The urethra is only a tube in the proper sense of the term when something is passing along it; when not so distended it has the shape of a crescent, with the concavity downwards. Opening into the penile urethra are numerous small lacunæ, which are really depressions of the mucous membrane. Of these the lacuna magna is the most noticeable; it opens on the roof of the urethra close to the meatus.

The mucous membrane is very vascular and well supplied with nerves. In the penile urethra it is thrown into longitudinal folds when the tube is not distended. The sub-mucous coat consists of elastic and white fibrous tissue, with involuntary muscular fibres, and the membranous urethra is further surrounded by the compressor urethræ muscle. The urethra is enclosed by erectile tissue, which is most abundant in its floor and in the penile portion.

In the prostatic portion there is a central elevation or crest—the verumontanum—on the summit of which is the depression of the uterus masculinus, and on each side of it one of the common ejaculatory ducts opens. The ducts of Cowper's glands open into the floor of the urethra near the bulb.

The **female urethra** is about one and a half inch long, and is surrounded by muscular tissue. The mucous membrane is thrown into longitudinal folds, and the orifices of glands and lacunæ open on to it. Owing to the slight resistance offered by the surrounding structures the urethra can be widely dilated, and if this be done rapidly it recovers its normal state within a few days.

URETHRITIS NOT DUE TO GONORRHŒA[1]

Causes. — Urethritis accompanied by symptoms similar in nature, but less severe in degree to those met with in gonorrhœa, may occur from a variety of causes.

Some people are specially prone to catarrh of the mucous membranes, and in such urethritis is not only easily excited by trivial causes, but tends to be very persistent.

Foreign bodies, instrumentation, especially if frequently repeated or if the instrument be tied in, and the use of strong injections in the hope of warding off venereal disease which the patient fears he may have contracted, not infrequently set up a fairly profuse discharge, which, however, speedily disappears with the removal of its cause. The presence of the menses, of leucorrhœa, or any other irritating vaginal discharge will also excite urethritis. Urethral chancre and stricture set up slight inflammation accompanied by a gleety discharge. Gout and tubercle may affect the prostatic urethra and cause troublesome chronic urethritis. Beer-soakers are not infrequently the subjects of the affection.

Symptoms. — The discharge in cases of urethritis of non-gonorrhœal origin may be slight or copious, muco-purulent, or purulent, but is often milky or watery. Pain may be slight or severe, and may be referred to the penile urethra or neck of the bladder according to the seat of the inflammation. In gout and tubercle as the disease is in the prostatic or membrano-prostatic urethra the symptoms are chiefly referred to the perineum and neck of the bladder and frequency of micturition is marked.

Treatment must be directed to the removal of the cause. In mild cases due to local irritation nothing is required beyond its cessation, but when none such is found and the inflammation is fairly acute, a mild injection of zinc permanganate as recommended for gonorrhœa may be employed, and the patient should rest as much as possible. Dilute alkaline drinks, salines, and hot baths are also to be recommended; if there is much pain and irritation, a morphia or belladonna suppository may be occasionally used (see Gonorrhœa, p. 156, vol. i.; Gleet, p. 578, vol. iii.). In gouty cases attention to the diet and general health is of great importance.

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[1] For Gonorrhœa, see p. 156, vol. i.

URETHRAL CHANCRE

The Hunterian chancre is occasionally met with at the meatus, and rarely within the last inch or so of the urethra; in the former situation the diagnosis is not likely to be attended with difficulty, but when the lesion is within the canal it may be overlooked for some time, or the symptoms may be attributed to some other cause.

There will be some difficulty attending the act of micturition with perhaps slight smarting and diminution of the stream, and hence stricture may be diagnosed. There is a gleety discharge, which may be definitely purulent, but is rarely copious. Examination will reveal a localised, densely indurated, painless patch in the urethra and corpus spongiosum; the dorsal lymphatics will be cordy and the glands in the groin are enlarged. The urethral speculum will reveal the surface of the sore. In the course of time secondary symptoms make their appearance.

Treatment is that for syphilis. If the chancre is within the urethra, a slender mercurial bougie should be passed each night to promote its cure.

GLEET

By gleet is meant a chronic urethral discharge which is often milky in character, scanty in quantity, and only met with in the morning or on squeezing the penis. It is unaccompanied by the scalding pain and usual symptoms of urethritis, but often causes frequency of micturiton, a feeling of weight and throbbing in the perineum, and irritation referred to the neck of the bladder. Occasionally without appreciable cause or from alcoholic or sexual excess, riding, bicycling, dancing, and the like, the discharge becomes more copious and purulent, and the local symptoms are more pronounced.

Causes.—Gonorrhœa is undoubtedly responsible for the vast majority of gleets, and this is especially likely to be the case if the disease has spread to the deeper parts of the urethra, and has excited prostatic congestion or inflammation, and additionally so if the treatment has been neglected or injudicious.

Stricture is a fertile source of gleet, and Otis goes so far as to say that in practically all cases of this disease a narrow patch will be found somewhere in the urethra, although the diminution of distensibility may be so slight that the term stricture cannot well be applied to it. Such narrowed areas are frequently the seat of granular patches (*granular urethritis*), or there may be definite ulceration.

Urethral warts, polypi, chancres, etc., may also cause a gleety discharge. The subjects of gout frequently suffer from gouty prostatitis, and gleet from the prostratic urethra.

Diagnosis.—The diagnosis of the cause, and hence the determination as to the proper treatment of any given case of gleet, must be made by an examination of the urine, of the urethra, and of the prostate.

The urine will be found to contain shreds, and on standing will deposit a little flocculent mucus. The shreds consist of mucus, epithelial scales, pus cells, and perhaps phosphatic crystals; they are usually long and twisted, but may be short and numerous. The patient should pass the urine in two portions into separate glasses; if the shreds are only present in the first portion, the cause of the gleet is probably in the penile urethra, but if the prostatic urethra is affected, the last portion will be shreddy; if this is turbid the bladder itself is probably diseased.

It is always advisable not to draw the patient's attention to shreds in his urine for these if they constitute the only real condition present, and are but few in number, do not give a sufficient reason for local interference, and the knowledge that he is passing them by no means infrequently causes the patient much mental anxiety in spite of any reassurances he may receive. Such shreds can often be found in the urine of patients who have not had gonorrhœa for years, and who have had no cause to complain of the urethra.

The urethra.—A full-sized Lister's sound (9 to 12 English) should first be passed, and a mental note should be made of any resisting patch which may be present, or of any pain which the instrument may cause. If it occasions acute burning pain at any spot, a patch of ulceration or of granular urethritis is to be suspected; as the instrument is withdrawn the pain at once ceases, and perhaps a drop of blood may follow. Chronic prostatic inflammation is usually characterised by intense burning pain, as if the instrument were red-hot as it passes into the bladder, but subsiding immediately on its removal. The pain may also be referred to the rectum and perineum.

Free bleeding, unaccompanied by great pain, is suggestive of the presence of warts. If a definite stricture be found no further examination is needful, nor is it indeed advisable at the first sitting.

The endoscope.—If the sound has shown pretty clearly that the disease is in the penile urethra, the endoscopic tube need not be passed beyond the triangular ligament; this is a much less painful and severe examination than if the deeper parts are brought into view, and does not usually require the use of cocaine. If the prostatic urethra is to be examined, the patient should sit at the foot of a raised couch, with his legs over the end and his back against a rest; the clothing should be slipped down below the knees. About twenty drops of a 5 or 10 per cent solution of cocaine is then introduced into the urethra by means of Guyon's or Ultzmann's syringe, and is retained for a few minutes by the patient grasping the end of the penis. The tube is then introduced (No. 18 or 20), and when it has been passed to the triangular ligament, its onward progress is facilitated by depressing the end of it between the thighs—this usually causes some pain. The urethra is now mopped out, the light is adjusted to the tube, and the examination of the canal is carefully made, and local applications applied according to the conditions found.

Chronic inflammation of the mucous membrane is indicated by patchy redness and the presence of muco-purulent matter on the surface; associated with this may be seen bright red, velvety, easily bleeding areas (*granular patches*), but if these have healed white patches wanting the free elasticity of the healthy urethra will be present. Warts are easily recognised as definite projections from the mucous membrane. The urethral follicles may be the seat of a chronic inflammatory process excited by gonorrhœa, and if so, pus will be found welling out of the dilated openings.

The prostate and vesiculæ seminales should be examined per rectum. In many cases of gleet they will be found to be indurated, slightly enlarged, and tender in consequence of chronic congestion and inflammation.

Treatment.—Few affections require more patience for their cure on the part of patient and surgeon alike than does gleet. As the condition usually causes but little real inconvenience or pain, the patient is too apt to neglect the directions given him, and to commit indiscretions which not only militate against successful treatment, but aggravate the condition. He should be prescribed a plain diet, but must abstain from highly seasoned dishes, sauces, etc., a little stout or good claret is often to be recommended, especially if, as is frequently the case, the general health is low; sparkling wines and coffee should not be taken. Moderate walking exercise is beneficial, but riding, dancing, etc., must be avoided. Gout, rheumatism, or any other general condition should receive appropriate treatment and residence at the seaside, or if circumstances permit, a sea voyage will do good if the patient is much pulled down. Fellows' syrup is a good tonic.

The local treatment must depend upon the condition present. If the gleet is due to chronic prostatis and vesiculitis, the treatment recommended on p. 563 should be enforced. Warts must be removed (p. 594), and a narrow patch dilated by the passage of a fulled-sized steel bougie every second or third day, or in more marked cases it may be divided, and should be so treated if recontraction quickly occurs after dilatation.

Granular patches and inflammatory areas must be treated locally by a solution of silver nitrate (grs. 5-20 ad ℥i.) applied by means of Guyon's injector, or through the endoscopic tube.

The patient should be warned that after this treatment he will experience smarting during micturition, and may pass a few drops of blood, and that the discharge will temporarily increase, but after about thirty hours will again diminish. The application should be repeated about every seven or ten days according to the amount of irritation it causes, and several sittings may be required before cure is complete.

Injections are only of service when the penile urethra is the seat of the mischief, for the patient is unable to make them reach the deeper parts. The injections must be astringent and stronger than those used in acute gonorrhœa; the sulphates of zinc (grs. 5), or copper (gr. ½), alum (grs. 5), or tannic acid (grs. 5) are the best, and should be used in conjunction with treatment through the endoscope, the first injection being made about two days after the sitting, *i.e.* when the initial irritation is subsiding.

In all cases of gleet if the meatus is narrower than it should be it must be enlarged towards the floor; this alone will sometimes cure the discharge, which frequently comes from immediately behind it.

ORGANIC STRICTURE

The urethra is said to be the seat of organic stricture when it cannot be fully dilated. It is customary to speak of this as being a contraction of the urethral canal, but this is hardly correct, since the urethral passage is only a canal when its walls are distended by the passage of urine, semen, or instruments along it.

Causes.—The stricture tissue is a scar, similar in every respect to such as results in any soft structure from injury or chronic inflammation. By far the most common cause of its occurrence is gonorrhœa, although such may have occurred months or years before stricture is established, and in the majority of cases even repeated gonorrhœa leads to no such result.

Rupture of the urethra also causes very dense and intractable stricture (p. 344, vol. ii.).

Congenital stricture is sometimes met with near the meatus (p. 310, vol. i.).

Seat and morbid anatomy.—About 70 per cent of all organic strictures requiring surgical treatment are situated at the junction of the bulbous and membranous urethra; of the remainder about 17 per cent occur within two inches from the meatus and the rest in the intervening portion. Slight degrees of stricture near the meatus are numerically very common (Fig. 171).

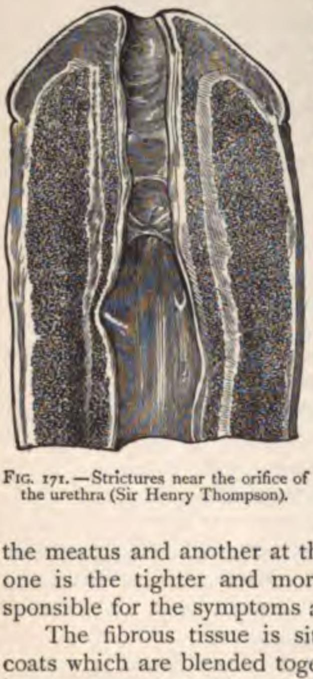

FIG. 171.—Strictures near the orifice of the urethra (Sir Henry Thompson).

Stricture does not occur in the prostatic urethra, although such cases have been described; the membranous urethra may be the seat of traumatic stricture, but is not affected by those due to gonorrhœa unless the stricture at the bulb is severe, and by extending backwards implicates the end of the membranous portion.

The stricture tissue is usually only met with at one spot, but sometimes strictures are multiple (Fig. 171); thus it is not uncommon to find one near the meatus and another at the bulb, and in such a case the deeper one is the tighter and more difficult to dilate, and is mainly responsible for the symptoms and consequences which may ensue.

The fibrous tissue is situated in the mucous and submucous coats which are blended together and rendered dense and unyielding, proportionately to the duration of the mischief. Sometimes the new tissue is so dense and inelastic that it cannot be dilated, or only so to a very slight extent (*indurated or cartilaginous stricture*), or it may yield readily but recontract in a very short time (*resilient stricture*). Most strictures, however, occupy a mid-position in these respects; they can be easily dilated and recontract very slowly and can be kept fully dilated by the occasional passage of an instrument.

The stricture tissue is in the floor of the urethra and may be quite limited in depth or extend deeply into the tissue of the corpus spongiosum. As a rule, the longitudinal extent is short, but may reach or even exceed an inch in length; in such cases the tissue is often of unequal density and contraction at different points, so that the lumen of the canal is tortuous (*corkscrew stricture*). Although the scar tissue is most abundant in and is usually confined to the floor of the urethra it may completely encircle it (*annular stricture*); when in the floor the scar may project into the canal as a narrow band or fold (*bridle stricture*), and sometimes such a fold being perforated at its attached part by an instrument, forms a band of tissue crossing the canal (*pack-thread stricture*).

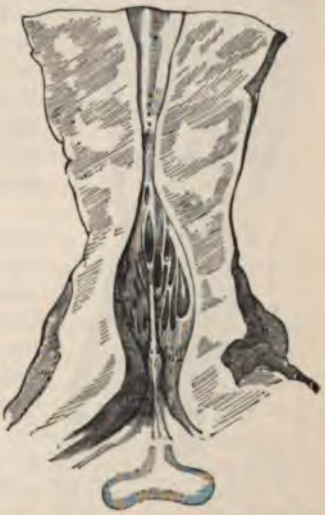

FIG. 172.—A narrow stricture of the urethra; behind it the urethra is dilated and reticulated (Sir Henry Thompson).

The degree of narrowing which a stricture causes depends in great measure upon its age; old strictures, especially those due to injury, may be very tight so that only the smallest instrument can be introduced, and even an attempt to pass such may fail, but a stricture never quite obliterates the urethral passage as the term *impermeable* might seem to imply. All strictures are permeable to fluid, and the number of those impermeable to an instrument diminishes with the skill of the operator.

In front of a stricture the urethra is quite healthy, at the seat of it the mucous membrane is puckered and indurated, greyish or opaque-white in colour, and may be superficially ulcerated, behind the stricture the tube is dilated proportionately to the degree of obstruction; the lacunæ may be distended into little pouches and the reticulated mucous membrane shows evidence of chronic inflammation. Occasionally a phosphatic concretion may form in this situation. In severe and long-standing cases changes in the bladder and kidneys occur owing to the obstruction to the free passage of the urine (see p. 506).

Signs.—The signs of stricture are gradually developed and are usually steadily progressive. A slight gleety discharge, often aggravated by sexual or alcoholic indulgence, is a common and very suggestive symptom and should always lead the surgeon to explore for stricture. Frequency of micturition is common though not always present; when a stricture is tight and the patient is unable to empty his bladder, frequency of micturition is a marked sign, and in the worst cases the urine constantly flows away from the over-distended bladder.

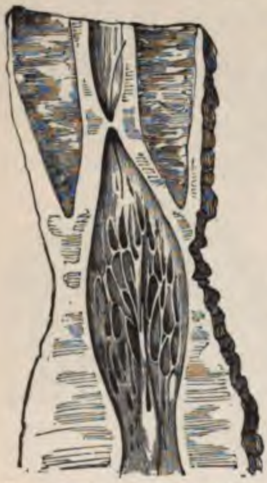

FIG. 173.—A very narrow stricture in the bulbous portion of the urethra through which a bristle has been passed. The urethra on the vesical side of the stricture is dilated and reticulated (Sir Henry Thompson).

One of the earliest symptoms is dependent upon the retention in the urethra behind the stricture of a few drops of urine after the patient has emptied the bladder; having, as he thinks, voided all his urine he finds that a few drops trickle down his leg after he has adjusted his dress. Micturition is difficult, and hence the patient strains in order that by increased *vis à tergo* the urine may be propelled through the narrow portion of the canal. This difficulty is gradually progressive and may be much increased, or even complete retention be caused by temporary congestion of the stricture. The repeated straining may cause prolapse of the anus with the passage of flatus during micturition, and in some cases hernia is induced.

If the act of micturition is watched, it will be noted that the patient strains and concentrates his attention on it; the stream is narrowed in proportion to the size of the stricture, and it is often twisted or forked.

Physical examination.—To determine the presence of stricture the surgeon should very gently attempt to pass a soft No. 8 English bougie; if this passes easily a larger one should be tried, but there is no occasion to go beyond No. 12. It should be noted if the instrument passes easily and smoothly, or if it is "held" or "grasped" at any point, and if it causes pain. The position of the stricture or strictures, if there be more than one, should also be ascertained.

If No. 8 will not pass readily no force is to be used but a smaller instrument must be taken, and so on until a size is found which will enter the bladder easily. In advanced cases it may be impossible to pass any instrument, and the treatment then to be followed will presently be discussed (*impermeable stricture*).

Errors and dangers of catheterism.—An instrument may catch at the lacuna magna and may meet with some slight resistance at the bulb, at the triangular ligament or the neck of the bladder, and a diagnosis of stricture may thus be made when none is present. Some such slight impediment is but momentary, and the bougie will quickly pass on readily enough if a little steady and gentle pressure be used. If the instrument catches in the lacuna magna it must be withdrawn and reintroduced.

If a stricture is found in the penile urethra, an instrument which will readily pass it must be pushed on into the bladder in order to ascertain that no stricture is present further back.

It is of great importance that no force be used to overcome any obstruction which may be encountered or the instrument may pass out through the urethral wall and make a false passage. *False passages* are usually made along the floor, near the junction of the bulbous and membranous urethra; the instrument may pass up a long distance outside the urethra, may again enter it behind the stricture and so reach the bladder, or may be pushed through the rectal wall.

When a false passage is made the instrument suddenly slips and often turns in the surgeon's hands, who is usually quite conscious of what has happened; the patient complains of sudden and perhaps severe pain, and blood escapes from the urethra. False passages ought not to be made, they are evidences of inexpert and rough treatment; they are often made by the patient himself, especially if he uses a stiff and unyielding instrument. Should such an accident happen, all instrumentation must be abandoned for a week so that the damage may be repaired. Extravasation of urine does not occur as the result of a false passage, since the track made by the instrument is in the opposite direction to the flow of urine; but if the instrument is not clean suppuration and sloughing may ensue.

Old sinuses, the result of false passages, may cause much difficulty in catheterism, the instrument repeatedly slipping into the sinus instead of passing along the urethra; if this should occur a curved instrument should be tried, its beak being kept close along the roof of the urethra; if this fails a catheter may be passed into the false passage and left there so as to block it while another is passed by its side in the hope of its continuing along the urethra. The occurrence of acute orchitis or of some form of urinary fever after catheterism must be borne in mind, and as far as possible prevented by gentle manipulation.

Treatment of simple uncomplicated stricture.—In the treatment of stricture the guiding principles which must be followed are: (1) the normal distensibility of the canal must be restored; (2) it must be maintained; and (3) these essentials must be obtained in the easiest and safest manner possible under the circumstances of the individual case.

Treatment by dilatation.—Dilatation may be effected by two methods—the *gradual* and the *continuous*; the former is the best, as it is the least likely to upset the patient and does not interfere with his usual avocations. Forcible or sudden dilatation, or rather, violent rupture of the stricture tissue, is a dangerous and justly condemned operation.

Gradual dilatation by means of bougies should always be first tried except in cases of tight stricture near the meatus which always require division. A soft, highly-polished, flexible bougie which will readily pass the stricture should be used and the operation should be repeated every second or third day, larger instruments being employed, until No. 12 E. passes easily. Thus, if the stricture will take No. 3 on the first day of treatment, 3, 4, and perhaps 5 may be passed on the third day, 5, 6, and 7 on the fifth, and so on, but the largest used should always pass readily and without pain. Lister's graduated sounds are preferable to a soft instrument when No. 5 can be passed, but below this a metal instrument is so small that it can readily be pushed through the wall of the urethra, especially by those who are not frequently in the habit of passing instruments. If no untoward effects are produced by this treatment it should be persevered with until the distensibility of the canal is re-established, or until it be found that the stricture is so dense that dilatation beyond a certain point is impossible. In most cases strictures are easily dilatable, and when dilated slowly recontract, but this can be prevented by the occasional passage of an instrument; in cases of resilient stricture internal urethrotomy must be performed.

Continuous dilatation is especially applicable to cases in which cure must be effected as soon as possible and to such as present difficulties in passing an instrument. In the latter class of case when by continuous dilatation the stricture has been dilated, say to No. 5 or No. 6 E., the gradual method may be substituted.

Continuous dilatation has the following disadvantages:—(1) it confines the patient to bed and prevents him working; (2) the constant presence of the catheter is sometimes badly borne, exciting irritation and restlessness, or perhaps urinary fever, which necessitates the abandonment of the treatment.

The patient's bowels having been well acted on the night before, a catheter must be passed which lies easily in the stricture; it must not "fit" or be grasped, for if this be the case it will excite some degree of irritation. The instrument should just enter the bladder and must be tied in, the end being plugged with a piece of wood which the patient can remove when he desires to void the urine. In twenty-four hours the instrument is withdrawn, and one a couple of sizes larger can then be easily passed. This is again replaced by a yet larger one on the following day, and so on until full dilatation is effected or the gradual method is substituted. The constant presence of a catheter often causes a considerable flow of thick muco-pus, but this quickly subsides when the irritant is removed. For the first day or so of the treatment the patient may complain of pain along the urethra and across the loins, and the temperature may rise a few points, but unless the symptoms are severe the catheter need not be removed; they usually soon subside.

Failure of treatment by dilatation.—Dilatation may fail in its object (1) because the stricture tissue is so dense that it will not yield; (2) because it is so elastic that although full dilatation can be easily secured the scar tissue immediately recontracts; (3) because the mechanical irritation of the urethra excites urinary fever or orchitis.

In such cases it is better to at once perform internal urethrotomy; but if the urinary fever is but slight, a second attempt at dilatation may be made which the patient may tolerate well.

Treatment after dilatation.—The patient must be instructed to keep the passage dilated by the occasional passage of a bougie. It is best to give him a nickel-plated Lister's sound (9 to 12 E.), for this is very readily kept clean, does not wear out or get rough on the surface, and owing to its weight can be passed with the greatest ease,—indeed it almost falls into the bladder.

The patient should at first pass the instrument every second or third day, preferably at night on going to bed; as time goes on he may gradually lengthen the intervals between passing the instrument until he may go as long as three months or more, but he must be warned that the scar is still present, and that if he neglects the directions given him, it will certainly recontract. The abuse of alcohol, cold, or undue sexual indulgence tend to excite congestion of the urethra, but provided its distensibility be equal to a No. 10 E., the amount of swelling which this may occasion cannot completely obstruct the passage, although it may cause difficulty in micturition.

Treatment by cutting operations.—Internal or external urethrotomy may be needed under certain conditions, but in the great majority of cases a stricture may be dilated by skilled hands.

Internal urethrotomy—*Indications.*—This operation is to be performed in all strictures near the meatus, in those which are indurated or resilient, and in cases in which treatment by dilatation excites orchitis or urinary fever, or if the patient proves in any other way intolerant of such treatment. In cases otherwise suitable for this operation, external urethrotomy is to be preferred if the urine be very foul.

Operation.—Strictures near the meatus may be readily divided by a bistoury-caché. Those more deeply placed should be cut with Berkeley Hill's urethrotome in the following way:—The fine flexible guide is passed through the stricture into the bladder; this may be easy or difficult; in the latter case patience and gentleness will usually prove successful, and a good plan is to distend the urethra with oil, when the small guide will often pass through the stricture. The split metal conductor is now screwed on to the guide, and is carefully passed along the roof of the urethra into the bladder. When it is in position the knife is fitted into the groove (the blade towards the floor of the urethra), and is gently pushed on until it meets with resistance. The spring is pressed and the knife is then pushed out, the resisting tissue is divided and the instrument passes freely along to the neck of the bladder. The instruments are withdrawn, the bladder is emptied through a full-sized evacuating catheter, and a half-grain morphia suppository is administered.

This operation causes but very slight bleeding, practically no shock, and is very rarely followed by constitutional disturbance or urinary fever; extravasation of urine need not be feared.

After-treatment.—The patient should retain his urine as long as possible, and for the first thirty-six hours he should micturate into a hot bath in which he should be placed about ten minutes before the bladder is emptied. This plan very much diminishes the pain attending micturition, which has usually quite gone at the end of the time mentioned, when the wound is glazed over. The patient should remain in bed for about ten days, when a Lister's steel sound, No. 9 to 12, can be readily and painlessly passed.

The patency of the canal must be kept up by the passage of an instrument as after treatment by dilatation (p. 587).

External urethrotomy—*Indications.*—When no instrument can be passed and immediate relief is necessary, the stricture must be divided from without by Wheelhouse's method.

Syme's operation is now obsolete since, if Syme's staff can be passed through the stricture, there is no bar to the performance of internal urethrotomy. Cock's operation consists in opening the urethra behind the stricture, and is really an operation for retention of urine due to stricture, and not for the stricture itself, which it leaves untouched.

Wheelhouse's operation.—The patient is placed in the lithotomy position, and the staff passed down to the stricture; an incision about one inch to one and a half inch long is made upon the lower end of the staff, and the urethra is opened just in front of the stricture. The sides of the cut are then held well apart by means of a long silk thread passed through each, so that hooks and assistants' hands are not in the field of operation.

The opening through the stricture is now sought for; a good light and patience are essential, for in many cases this part of the operation is extremely difficult and may occupy a very long time. When the opening is found a fine probe or probe-pointed director is passed through the stricture, the tissue is divided, and a full-sized catheter is passed from the meatus into the bladder to ensure the complete patency of the canal. In cases of great difficulty in finding the opening a little pressure over the pubes or on the vesiculæ seminales through the rectum may lead to its detection by causing the escape of a few drops of urine or semen.

After-treatment.—If the urine is foul an indiarubber catheter should be passed through the perineal wound into the bladder, which should be systematically washed out or drained.

The perineal wound will granulate, and at the end of a week or so a Lister's sound should be daily passed along the urethra to keep the passage clear. The subsequent treatment consists, as in all cases of stricture, in the occasional passage of a bougie.

The complications of stricture of the urethra.—The long-continued obstruction to the passage of the urine may lead to those secondary changes in the higher urinary tract which have been described on p. 506.

The formation of false passages and the occurrence of orchitis or of urethral fever in association with the passage of instruments have also been referred to, and it only remains to mention extravasation and retention of urine and the formation of perineal abscess and fistula as the direct results of the condition.

Extravasation of urine may be due to rupture of the urethra behind a very tight stricture with over-distension of the bladder, or it may arise in connection with a perineal abscess which bursts into the urethra behind the stricture. This subject is discussed under Injuries of the Urethra, see p. 346, vol. ii.

Retention of urine may be due to the gradual contraction of the stricture, so that only a few drops of urine can dribble away, or it may arise from temporary acute congestion due to cold, alcohol, or sexual indulgence, causing swelling of the mucous membrane and absolute closure of the narrowed passage.

In cases of retention due to gradual narrowing of the stricture, Wheelhouse's operation must be at once performed. If congestion is responsible for the condition, an attempt may be made to pass a fine soft instrument, and should this be successful, it must be tied in and continuous dilatation carried out. Failing this, and if the symptoms are urgent, the bladder may be aspirated above the pubes; the patient should then have the bowels emptied by an enema, and be placed into a hot bath into which he will pass some urine. If the kidneys are not diseased a morphia and belladonna suppository should be prescribed. This treatment by the hot bath may be repeated, and a further attempt to pass a catheter may be made under chloroform which obviates the spasm of the perineal muscles. If a catheter can be introduced continuous dilatation or internal urethrotomy should be done, but if no instrument will pass the stricture, Wheelhouse's operation must be performed.

PERINEAL OR PERI-URETHRAL ABSCESS

Peri-urethral abscess usually occurs beneath the deep layer of the superficial fascia, but occasionally a small collection of pus may form in connection with the penile urethra.

Causes.—Perineal abscess may arise from gonorrhœal inflammation of one of the urethral follicles or from injury, but is most commonly seen in association with stricture. The mucous membrane behind a stricture becomes ulcerated, and by a gradual extension of the process the surrounding tissues inflame and suppurate, and the urethra yielding, the cavity of the abscess contains pus and urine; or a similar process may arise by inflammation of a distended urethral follicle. Suppuration will also be induced if the urethra yields behind the stricture, but such a condition is more correctly considered under extravasation of urine (p. 346, vol. ii). False passages and the presence of foreign bodies in the urethra may excite perineal abscess, but rarely do so.

Signs.—Perineal abscess may be acute or chronic according to its cause. In the acute form the constitutional disturbance is often considerable, and is accompanied by high fever and intense pain, of a throbbing tensive character, felt in the perineum and about the neck of the bladder. Owing to the pressure on the urethra the stream of urine is much diminished or there may be complete retention. On examination a tense, hard, very tender, more or less oval swelling will be found in the perineum, but fluctuation must not be expected. Such an abscess may burst into the urethra, and discharging by that passage may, under favourable circumstances, heal, or it may gradually extend upwards, towards the scrotum or open on to the surface, sometimes at a distance and by several openings. If the urethra has already yielded the cavity containing putrid and often extremely offensive pus and urine may be very large, and the patient's general condition, especially if he be old and his kidneys are diseased, is one of extreme gravity.

Treatment.—A perineal abscess must be at once freely incised in the middle line, and the pus and urine let out. Even if it be found at the time of operating that there is no communication with the urethra, its wall will usually yield in a few hours and urine will escape; this must always be expected in cases complicating stricture. The cavity should be thoroughly cleansed by irrigation, and hot antiseptic fomentations should be employed for a few days.

In gonorrhœal cases healing will soon take place, but if stricture is responsible for the condition this must be at once treated, or urinary fistula will inevitably result.

PERINEAL URINARY FISTULA

If a perineal abscess does not heal, a urinary fistula results; such fistulæ are almost always met with in association with stricture which, by preventing the passage of the urine *per vias naturales*, necessitates its discharge through the artificial opening. A perineal fistula may thus be regarded as nature's method of compensating for the obstruction which a tight stricture occasions.

Although the communication with the urethra is always single, the external fistulous openings are frequently multiple; this is due to the fact that as the abscess cavity contracts, its external opening becomes very narrow, and hence the urine and pus, not having a free outlet, burrow in various directions. In the simplest cases, the external opening or openings are situated in the perineum, but secondary sinuses may open on the scrotum, penis, pubes, thighs, or buttocks; such sinuses are often very tortuous and narrow, so that their openings may readily be overlooked.

In the simplest cases the sinuses are supple, and the surrounding tissues are practically healthy, but when they have existed for a long time the walls of the fistulæ become dense and indurated, and the tissues chronically inflamed; these conditions very materially retard healing, even after the natural urinary passage has been restored to its full calibre. The amount of urine which escapes by the unnatural openings depends upon the degree of urethral obstruction; it may be merely a few drops which cause a certain feeling of dampness after micturition, or the entire urine may thus escape. The inconvenience caused will necessarily depend upon the number and situation of the fistulæ, the condition of the tissues, and the quantity of urine escaping; in some cases the patient may not suffer any great inconvenience or ill effects, even although the fistulæ have existed for many years.

Fistulæ which form as the result of some acute process accompanied by sloughing, may be very large, and require some plastic operation for their closure.

Treatment.—By due care in the treatment of perineal abscess, the occurrence of permanent fistulæ should be prevented. When a fistula is present the first indication is to re-establish the normal patency of the urethra, and in simple cases this will soon be followed by sound healing of the fistula. But in chronic cases with much induration, such a happy result cannot be expected, and much patience is necessary to effect a cure; in such it is of great importance that no urine be allowed to escape through the sinuses, and hence the patient should be instructed to draw off his urine with the catheter, and must never attempt to pass it naturally. The sinuses themselves may be stimulated by passing a probe coated with silver nitrate, by the use of sulphate of copper, and by the actual cautery. If they are much indurated and the openings are very small, these should be enlarged and the sinuses sharp-spooned. Inflammation about the perineum must be subdued, and absorption of inflammatory products favoured by the application of hot fomentations. Failing other means, the sinuses (unless they be very long and open at distant parts) must be slit up, sharp-spooned, and encouraged to heal from the bottom. Fistulæ requiring a plastic operation may be closed by freshening and suturing the edges, or by some more elaborate procedure similar to that employed for hypospadias.

STRICTURE OF THE FEMALE URETHRA

Stricture in women is very rare, and usually affects the meatus. It may be due to cicatrisation following some destructive lesion, laceration, or a chancre. Frequency and difficulty in micturition, perhaps with some pain, lead to an examination, when the nature of the case is easily ascertained. Treatment by gradual dilatation must be employed.

TEMPORARY URETHRAL OBSTRUCTION—"SPASMODIC AND CONGESTIVE STRICTURE"

The temporary obstruction to the flow of urine due to the impaction of a foreign body is discussed at p. 343, vol. ii. That spasm and congestion may cause some difficulty in micturition, and under certain circumstances, complete retention is well known.

Spasm of the peri-urethral muscular fibres, and of the compressor urethræ, is practically always dependent upon some source of irritation in the urethra, *e.g.* stricture, but in a minor degree it may also be excited by an irritating condition of the urine, such as is often met with in gouty people; cantharides can also produce it. During catheterism it is not uncommon to find that the instrument is suddenly grasped, and its onward progress arrested by spasm of the deep perineal muscles, but this is soon overcome if the instrument be retained in position for a few minutes by the weight of the hand. Similar spasm often occurs in the subjects of stricture, and hence the patient notices that at times his stream of urine is decidedly less than usual. Spasm of the urethra, or as it has wrongly been called, spasmodic stricture, is far more frequently met with in the practice of the inexperienced, and sometimes serves as a useful excuse for inability to pass a catheter.

Treatment.—Hot baths, morphia and belladonna suppositories, and free action of the bowels, will soon allay any spasm which may be present.

Congestion of the urethra, when it is not the seat of stricture, is a matter of no importance, unless it complicates inflammation or enlargement of the prostate, and even then it is the prostatic condition which occludes the urethra.

Even slight congestion of the mucous membrane at the seat of a stricture may suffice to temporarily completely close it and cause retention of urine. Congestion may be caused by cold, alcoholic or sexual indulgence, injudicious catheterism, or by gonorrhœal inoculation. The degree of obstruction which congestion produces depends upon the narrowness of the stricture, or the degree of prostatic mischief.

Treatment.—The congestion must be abated by the same means as recommended for spasm. In cases of stricture or prostatic disease, the congestion, if it produces complete retention, will necessitate catheterism or some more formidable treatment for its relief (see pp. 572, 590).

TUMOURS OF THE URETHRA

Innocent tumours—Papillomata.—Warts similar to those met with on the glans and prepuce may occur in the urethra; they are usually found in the last couple of inches or so, but may occur anywhere, and are not very uncommon in the membrano-prostatic portion. They may be single or multiple, sessile or pedunculated, but rarely attain a large size.

Polypus.—Mucous polypus is occasionally met with.

Symptoms.—These growths give rise to a persistent gleet, and occasionally attain a sufficient size to cause obstruction to the flow of urine and the symptoms of stricture. There is no pain, but the passage of a bougie or of the endoscopic tube, often leads to smart bleeding, and may detach the growth. The diagnosis is confirmed by the endoscopic tube, through which the wart must be treated.

Treatment.—Under cocaine these small growths may be destroyed by touching them with sulphate of copper, or if larger and pedunculated they may be cut off with urethral scissors or torn away with forceps, the base being touched with sulphate of copper or silver nitrate. After removal, the gleet which they occasion will quickly subside.

Vascular caruncle occurs at the meatus of women, but the causes leading to the growth are not known. The tumour is composed of a fibrous basis enclosing large vascular spaces; it is richly supplied with nerves, and has an epithelial investment. It may be sessile or pedunculated, and usually grows at one part of the meatus through which it projects. It is commonly about the size of a pea, but may be larger, and has somewhat the appearance of a piece of raw liver. The patient's attention is drawn to the urethra by the pain on micturition, which may be agonising, and may also render coitus or even walking unbearable. The nature of the case is revealed by ocular examination.

Treatment.—A general anæsthetic is to be preferred, but if the growth is small, cocaine (20 per cent) may suffice. The caruncle may be destroyed with the actual cautery, or cut away with scissors, after which its base should be cauterised; it is usually very easily torn, and breaks down if any attempt be made to hold it in forceps.

Malignant disease.—**Squamous epithelioma** may secondarily affect the urethra by gradual extension, or by the formation of isolated nodules along the corpus spongiosum; but the primary disease is very rare. Induration, pain, discharge, and obstruction to the flow of urine will be the leading symptoms, and the endoscope will be needed to establish the diagnosis.

Amputation of the penis must be performed.

CHAPTER XXVII

DISEASES OF THE PENIS AND SCROTUM

DISEASES OF THE PENIS

CONGENITAL PHIMOSIS

IN congenital phimosis the preputial orifice is narrowed, often to a mere pinhole, so that the glans penis cannot be uncovered. In most cases the prepuce is also redundant, and may form a long trunk-like portion of skin at the end of the penis. Adhesions between the prepuce and glans are common, and may be universal.

Effects.—It not infrequently happens that the fact of phimosis is quite overlooked by the child's attendants, and he is placed under treatment for one or other of the effects which the condition may occasion.

When the orifice is very small, there is frequency of micturition, accompanied by pain, and nocturnal incontinence is common. Consequent on straining, there may be prolapse of the anal mucous membrane or inguinal hernia. The pain and irritation induce the child to pull at the end of the penis, and this not only tends to increase the irritation but further elongates the prepuce, and may lead to early sexual excitement and eventual masturbation. The difficulty of micturition, coupled with evidence of vesical irritation, may simulate the symptoms of stone. If the prepuce is forcibly retracted, paraphimosis may be occasioned. When the orifice is very small, some of the urine remains behind between the glans and the prepuce and distends the latter ("*ballooning*"). This urine putrefies, and being mixed with retained smegma, excites balano-posthitis.

Calculi are sometimes found beneath the prepuce due (1) to inspissation of the smegma and its admixture with lime salts; (2) to the deposit of phosphates from retained and putrid urine; or (3) to the lodgment of a vesical calculus which has passed the urethra, but is unable to escape through the narrow preputial orifice.

In later life phimosis may cause considerable sexual irritation, and during connection the prepuce may be fissured and torn, or being forcibly retracted para-phimosis may result. Owing to the difficulty of retracting the foreskin and ensuring perfect cleanliness, venereal disease is more likely to occur in the subjects of phimosis than in others exposed to infection; and this is, moreover, further predisposed to by the probable occurrence of fissures and cracks. In later life the repeated irritation caused by attacks of balano-posthitis may result in the development of epithelioma.

Treatment.—The prepuce should be removed. Attempts at gradual dilation of the orifice are not to be recommended.

ACQUIRED PHIMOSIS

Acquired phimosis is due to inflammatory swelling or cicatricial contraction consequent on chancres, fissures, or repeated attacks of balano-posthitis. The acute inflammatory form is often seen in association with gonorrhœal balano-posthitis, and with chancres of the glans or inner surface of the prepuce. In such cases the prepuce is much swollen, and œdematous; putrid pus drips away from the orifice, and all attempts to expose the glans cause great pain.

Acquired phimosis may also be due to an enlargement of the glans, such as may result from the growth of papillomata or epithelioma.

Treatment.—When the condition is due to chronic cicatrisation, circumcision should be performed. In acute inflammatory cases the prepuce should be slit up along the dorsum, so that the glans may be fully exposed and examined and any chancre or other morbid condition present be appropriately treated. When the prepuce has been divided, the patient should be placed in a hot boracic bath for some hours until the inflammation has been subdued. At a later date, when the primary morbid condition has been cured, the operation of circumcision should be completed by trimming up the halves of the foreskin.

CIRCUMCISION

In all but quite young children a tape should be tied round the root of the penis to prevent hæmorrhage, which will otherwise obscure the view. It is important not to remove too much prepuce as a rule, it should be cut about on a level with the corona or slightly in advance of this, so that this part may not be quite uncovered. The prepuce is drawn sufficiently forwards and grasped obliquely downwards and forwards between the handles of a pair of scissors, just in front of the glans. The portion thus isolated is put on the stretch and cut off with a sharp knife, the scissors being at once removed. The mucous membrane must be separated from the glans with a director if any adhesions are present, and then slit up along the dorsum; all inspissated smegma is removed. The mucous membrane is now cut away about an eighth of an inch from the glans penis, and the cut margin is united to the edge of the skin by a few points of fine catgut. Care must be taken not to leave much mucous membrane on each side of the frenum, or troublesome œdema will occur. Before the sutures are inserted the tape should be removed, and any bleeding points secured by torsion or fine catgut ligatures. In infants no sutures are necessary, and no dressing is really needed, but a small strip of butter-cloth covered with boracic lint may be rolled round the end of the penis. The nurse should be instructed to keep the child as dry as possible.

In older children and adults the best dressing consists of a narrow strip of gauze, outside which is a thin layer of wool, the whole being fixed on by collodion, which may be removed on the third day when healing will have occurred. Sometimes a small granulating patch is left near the frenum, but this will soon heal if kept clean and covered with a piece of butter-cloth and boracic ointment. In the case of adults, erections may be prevented, or at least minimised, during the healing process by the use of a suppository of morphia, gr. ⅓, and camphor, grs. 3.

PARAPHIMOSIS

Paraphimosis may result when a tight prepuce is forcibly drawn behind the corona. The condition is usually met with in little boys, but may occur in adults during connection, or in association with some venereal trouble. The prepuce is much swollen and œdematous, and of a red colour, deepening to purple or even black, if gangrene occurs. The glans is also much congested. The pain is considerable, and is much increased by the difficulty or impossibility of micturating. The swollen prepuce forms a collar round the corona, and behind this is a deep sulcus at the point of constric tion. If the condition be left unrelieved, the prepuce becomes gangrenous, and spontaneous relief is thus afforded. In severe cases even the glans penis may slough.

When the strangulation is not very acute or severe, the condition may become more chronic and the swollen prepuce dense and hard; such a condition is not infrequently seen after eczema of the genitals.

Treatment.—The patient may be anæsthetised, but this is not essential. The penis being grasped between the index and middle fingers placed behind the point of constriction, an attempt is made to draw the prepuce forwards, while at the same time the thumbs, placed against the glans, endeavour to push it backwards; this may be facilitated by general compression of the parts, to diminish the congestion and œdema. If this succeeds, the œdema and swelling quickly subside.

If attempts at reduction by the above method fail, the constricting band must be divided on the dorsal aspect, just behind the corona; this is best done by slipping a director under the prepuce, and cutting backwards towards the narrow sulcus. Reposition is then easy.

When the inflammation and swelling have subsided, the propriety of performing circumcision must be considered.

BALANO-POSTHITIS

Causes.—Inflammation of the mucous surfaces of the glans penis and prepuce is usually dependent upon gonorrhœal infection, or the presence of a venereal sore, and is especially liable to occur if the prepuce is long and tight and the patient of uncleanly habits. In some cases the inflammation is independent of venereal trouble, and is excited by retained and putrid smegma. Gouty people and diabetics are also liable to attacks of balano-posthitis, which run a subacute course and are very liable to recur.

Signs.—There is considerable itching, irritation, and heat about the end of the penis, but rarely any actual pain. The prepuce may be found considerably swollen from œdema, and inflammatory phimosis may be present, a foul discharge dribbling from the opening in the prepuce. If the foreskin can be retracted, and the retained smegma and discharge is cleared away a venereal sore may be detected; but in any case, the mucous membrane will be found to be red, glazed, and more or less studded with patches from which the epithelium has separated. Superficial erosion is common, and in severe cases the destruction may extend more deeply or the prepuce may slough.

Treatment.—If there is inflammatory phimosis, the prepuce must be slit up along the dorsum so that the glans can be thoroughly examined. The parts must be kept clean by douching with boracic lotion, which in bad cases may be continuously applied in the form of a bath; or if there is much irritation and itching, lead and opium lotion may prove more soothing. In simple cases due to retained smegma, the above treatment will allay the trouble in a day or two; but if any venereal trouble is also present, this must receive the necessary treatment, and the balano-posthitis is likely to prove more persistent.

Gout and rheumatism must be appropriately treated when these conditions are present.

SLOUGHING AND GANGRENE OF THE PENIS

Diffuse cellulitis of the penis may occur as the result of some infective process (*e.g.* phagedæna or the acute fevers), or of neglected phimosis, paraphimosis, perineal abscess, or extravasation of urine. There is considerable œdema and pain; the skin is covered with a livid blush, and may become gangrenous in patches; the inflammation may involve the scrotal tissues, and spreads upwards to the abdomen and towards the thighs. Acute cavernitis may lead to suppuration or sloughing of the penis.

Treatment.—Any local cause, such as phimosis, must be relieved and the inflammatory process cut short by free incision into the cellular tissue, followed by the use of the hot boracic bath.

During the period of separation of the sloughs and subsequent repair, the parts must be kept as clean as possible by the use of iodoform and antiseptic lotions. The general treatment must be stimulating and tonic, as in all infective diseases.

HERPES PROGENITALIS

Herpetic patches similar to those met with about the lips and alæ nasi are often seen on the inner or outer surface of the prepuce, or on the glans penis. The disease is very liable to recur, and may be annoyingly persistent, each attack being sometimes traceable to coitus, to digestive disturbance, or to some slight impairment of the health, especially in those of a gouty or rheumatic tendency. Acrid secretion from the vagina may be responsible for an attack.

It is supposed by some that herpes is largely dependent upon antecedent venereal disease, but there is no direct proof of any such connection. Varicosity of the preputial veins is often an associated condition.

Signs.—The first sign to attract attention is itching and irritation; but there is rarely any pain, although this is occasionally pronounced. On examination a group of small papules, about the size of a pin's head, will be seen; these soon become vesicular, and later pustular. The vesicles or pustules may dry up and form a small scab, which separates in a few days, leaving the part healed. If the herpetic patch is irritated by the clothing, or by injudicious treatment, there may be some slight surrounding inflammation, and the patch may superficially ulcerate, the pustules coalescing and producing a sore which is too frequently diagnosed as of venereal origin. In rare cases the ulceration is more extensive, and considerable cellulitis and sloughing may ensue if infective organisms are inoculated at the abraded spot.

Diagnosis.—In the early stages the diagnosis is easy; but if the pustules have fused and an ulcer has resulted, the diagnosis from soft chancre is not so simple. Soft chancres usually occur about the frenum and corona, are very tender, and may be spontaneously painful; the glands in the groin are enlarged and not infrequently suppurate, whereas they are quite unaffected in herpes, unless accidental inoculation has led to considerable inflammation.

It must not be forgotten that a herpetic area may be inoculated with the poison of chancroid or syphilis, the characteristic lesion making its appearance after the inoculation period has passed. The diagnosis from hard chancre presents no difficulty.

Treatment.—The parts must be thoroughly cleaned with boracic solution, subsequently dried with a soft towel, and kept powdered with boracic acid, starch, or oxide of zinc. All irritation by the clothing must be avoided. Lotions as continuous applications are best avoided; but if there is much inflammation with superficial ulceration, lead and opium, boracic acid, or some similar non-irritating lotion may be employed. In persistently recurrent cases the digestive system must receive attention, and arsenic and vegetable bitters should be given internally. The patient should be instructed to observe perfect cleanliness, especially after coitus. Circumcision may be performed if the herpes especially attacks the prepuce, but the patient ought to be warned that it may come back on the glans, although this is unusual.

NEW GROWTHS OF THE PENIS

With the exception of papillomata and epithelioma, all new growths of the penis are very rare. **Nævi** are sometimes seen, and are readily treated by excision. **Sebaceous cysts** occasionally occur; they are usually in the prepuce, and may be treated by enucleation or circumcision.

Papilloma.—Ordinary hard warts, similar to those met with on the hands, are sometimes seen on the skin of the penis, and occasionally develop into definite horns.

The most usual form of papilloma is much softer, more vascular, and grows more exuberantly. These growths are traceable to irritation and are usually a sequela of gonorrhœa, but may occur from the irritation of retained smegma and repeated attacks of balano-posthitis. Papillomata usually begin to grow round the corona, but may ultimately spread over the entire glans and inner surface of the prepuce. They are quite superficial, and do not (unless becoming malignant) spread to the deeper tissues. In general appearance, a mass of papillomata resembles the head of a cauliflower; sometimes the individual growths are closely set together, but in other cases they are much looser. If the growths are irritated or confined beneath a tight foreskin, superficial ulceration, accompanied by balano-posthitis and an acrid offensive discharge, may result. Bleeding is sometimes profuse.

Papillomata may be the starting-point of epithelioma. Precisely similar growths are met with in females (see p. 647).

Treatment.—The simple hard wart may be eradicated by the use of salicylic collodion or by the application of nitric or glacial acetic acid. If a horn develops, or the wart proves refractory, it should be excised.

When quite small, soft vascular warts should be kept clean and dry, and may be destroyed by nitric or acetic acid; but when they are at all extensive the patient should be anæsthetised and the warts cut away with scissors, their bases being touched with nitric acid or lightly wiped over with the actual cautery in order to prevent recurrence. To avoid the inconvenience caused by the profuse bleeding, the warts should first be removed from the under surface of the glans penis, and finally from the dorsum. If necessary, the prepuce must be slit up to expose the growths, and it may be removed with advantage.

Epithelioma.—Epithelioma of the penis is not a common disease, and is predisposed to by chronic irritation such as may be occasioned by phimosis with repeated attacks of balano-posthitis. It usually begins as an irritated wart, or more rarely as a flattened tubercle or papule. The glans penis is the favourite seat of the disease (this being the part most often attacked by warts and most liable to irritation), but the prepuce or any part of the sheath of the penis may be primarily affected.

Signs.—However epithelioma begins, its course is characterised by progressive involvement of the deeper structures of the penis. The growth spreads over the glans and invades the prepuce, which becomes indurated and unyielding, so that it cannot be retracted but imprisons beneath it the discharges from the ulcerating surface. The meatus is often lost amid the mass of new growth, but is very rarely obstructed. By gradual extension backwards the vascular spaces of the corpora cavernosa become obliterated and are rendered solid by new growth, isolated secondary masses of which may be detected as small hard nodules along the penis. Invasion of the glands in the groins quickly occurs. The growth itself may present the usual characters of an epitheliomatous ulcer having a foul sloughy surface with everted edges and an indurated base, or it may present a papillomatous and more or less cornified appearance. The glands may attain a large size; they tend to break down and leave a ragged foul ulcerating mass, which, by gradual extension, may open up the femoral artery or some of its branches. The iliac glands may be also affected, but secondary deposits in the viscera are extremely rare. As the disease advances the patient loses health and strength, and at last dies of exhaustion.

Treatment.—Amputation or complete removal of the penis with the glands in the groin is the only available remedy. If this step is contra-indicated by the extent of the disease and the general condition of the patient, the ulcerating surface should be frequently cleansed with boracic lotion and lightly dusted with iodoform.

AMPUTATION OF THE PENIS

A catheter should be passed along the urethra to indicate the position of the corpus spongiosum, and a tape ligature tied round the root of the penis to control the bleeding.

A small dorsal flap is made, and the structures are reflected to the depth of the corpora cavernosa. From the under surface of the organ a shorter flap is dissected backwards. The penis is now held out straight, and the surgeon dissects through the corpora cavernosa at the level of the base of the flaps, and when these have been divided they are dissected forwards from the corpus spongiosum for about half an inch. The corpus spongiosum is now circularly divided, and the catheter is withdrawn with the separated portion of the penis on it. The tape ligature is removed, and the bleeding vessels are secured with chromic catgut or fine silk. The urethra is slit up along the dorsum and drawn through a slit made in the dorsal flap, to the margins of which slit the divided urethra is united by a few points of fine suture. The flaps are then united. As healing takes place contraction of the new meatus must be prevented by the daily passage of a bougie.

REMOVAL OF THE ENTIRE PENIS

When the cancer has invaded the greater part of the organ its complete removal becomes necessary. When this is undertaken the testicles should usually be simultaneously removed, for by this addition the subsequent condition of the patient is rendered much more comfortable, and the double castration does not add so much to the gravity of the operation as might be supposed.

The skin is circularly divided at the root of the penis, the scrotum is split along the raphé, and the testicles are removed.

The corpora cavernosa are followed backwards to their attachment to the bone, from which they are closely cut away, the vessels being ligatured as they are divided.

A catheter passed along the urethra will define its position, and the corpora cavernosa are then dissected forwards for some distance, and the urethra is separated. This is attached by a few points of suture to the margins of the scrotal wound, which is united elsewhere.

Healing is usually rapid; when union is complete the parts somewhat resemble the vulva.

DISEASES OF THE SCROTUM

ACUTE CELLULITIS

Causes.—A mild degree of inflammation of the scrotal cellular tissue often accompanies acute epididymo-orchitis, and may also result from injury. The most severe inflammation arises in connection with erysipelas, with extravasation of urine (especially if this be foul), and in neglected cases of perineal abscess or phagedæna (p. 118, vol. i.). Cellulitis may also be due to some acute fever, or may follow operations, *e.g.* that for varicocele.

Signs and effects.—Owing to the laxity of the scrotal connective tissue there is great and rapid swelling, though there is but little pain other than that which may result from some associated condition, *e.g.* perineal abscess. The scrotum is tense and œdematous, the skin stretched, shiny, devoid of rugæ, and covered with a red blush. The swelling may extend to the perineum and to the skin of the penis. In septic cases gangrene of the skin quickly supervenes, for although the scrotal tissues are very lax their vascularity is low.

Dark purple patches make their appearance and soon become greenish, or greenish-black. The skin sloughs, and there is a dirty, purulent, highly offensive discharge. The sloughing may be very extensive. The glands in the groin will participate in the inflammation and become enlarged and tender.

Constitutional symptoms are marked. The temperature runs high, and the patient is very ill, probably with marked asthenic symptoms. General blood-poisoning may readily ensue in consequence of the very rich lymphatic supply of the parts affected.

Treatment.—The cause of the condition must receive prompt treatment.

Tension must be relieved by free incisions, and the parts should be covered with hot antiseptic fomentations, or if the patient can stand the treatment he should be placed in a hot boracic bath; or continuous irrigation may be employed during the process of sloughing. The general treatment is that advocated for all infective processes, ample nourishment and stimulants being especially necessary in view of the asthenic condition of the patient.

When the sloughs have separated and granulation is in progress the strength must be supported during healing, which is often tedious, as these patients are frequently advanced in years.

SCROTAL HÆMATOCELE

Rupture of a vein as the result of injury gives rise to a rapid and large effusion of blood into the scrotum, accompanied perhaps by bruising of the skin. Scrotal hæmatocele is more likely to result from injury if the patient has a varicocele. The hæmorrhage may be so great as to induce faintness. Such a hæmorrhage may become in great measure absorbed, and a cyst containing dusty coloured fluid is ultimately formed. Suppuration sometimes occurs.

The diagnosis is made by the history of an injury, coupled with the rapid swelling and evidences of bruising.

In old cases where partial absorption has occurred, the case may be mistaken for hæmatocele or hydrocele of the tunica vaginalis.

Treatment.—The patient must be placed in the dorsal position, with the scrotum well raised, to which an ice-bag must be continuously applied. In about ten days or so, when the vessel is probably occluded and some absorption has taken place, the clot may be turned out after free incision and the cavity be left to heal by granulation. No attempt must be made to draw off or evacuate the blood until sufficient time has elapsed for the injured vessel to close, or the bleeding may continue, and has been known to prove fatal.

EPITHELIOMA OF THE SCROTUM—CHIMNEY-SWEEP'S CANCER

Epithelioma of the scrotum is a rare disease, although formerly it was fairly common among certain classes, but the more general recognition of the advantages of personal cleanliness coupled with the avoidance of other causative factors, have combined to lessen its frequency.

The disease usually occurs about middle life, and is nearly always distinctly traceable to some form of chronic irritation. Thus, chimney-sweeps and those working with paraffin, tar, and the like are specially liable to be attacked.

Signs and course.—Epithelioma of the scrotum runs much the same course as does the disease appearing in any other part of the skin.

Originating as a flattened tubercle, or in an irritated wart, a fissure or patch of chronic eczema, the ulceration gradually spreads in extent. At first the growth may be covered with a scab, but after a time it forms a fungating mass with overhanging edges and a foul unhealthy base. In some cases the superficial ulceration is very limited in extent, and the indurated growth resembles an extensive wart. As the disease extends in depth the testicle may become implicated.

The inguinal glands enlarge from secondary deposits, and as softening occurs a large, foul, fungating ulcer, or deep pit may form in the groin. If the ulceration extends deeply, profuse or even fatal hæmorrhage may occur from the branches of the femoral or from the main trunk.

If the testicle is implicated secondary deposits will occur in the pelvic lymphatic glands. Secondary glandular disease is sometimes postponed for a long time, and, speaking generally, epithelioma of the scrotum may be said to offer a somewhat better prognosis than epithelioma elsewhere, the lip excepted.

Treatment.—Complete removal of all the diseased parts, including the testicle and lymphatic glands if they are affected, must be at once performed.

Even in cases where the extent of the glandular mischief is such as to preclude the possibility of complete removal of the disease, the primary focus may be advantageously removed and the patient's remaining life rendered more comfortable, in the absence of a sloughy, painful, and intensely fœtid mass of new growth.

INNOCENT TUMOURS OF THE SCROTUM

All innocent tumours of the scrotum are rare. **Fibro-fatty** tumours, **nævi, sebaceous, serous,** and **hydatid cysts** are those to be specially borne in mind. Nævi are usually cutaneous, but sometimes form a definite venous mass beneath the skin; they are easily removed by the knife. Sebaceous cysts are usually multiple (Fig. 174), but do not often attain a large size; they may persist for many years, the contents becoming inspissated or even cretaceous; in other cases, especially if irritated, they may break down, ulcerate, and assume malignant characters. These cysts are easily dissected out.

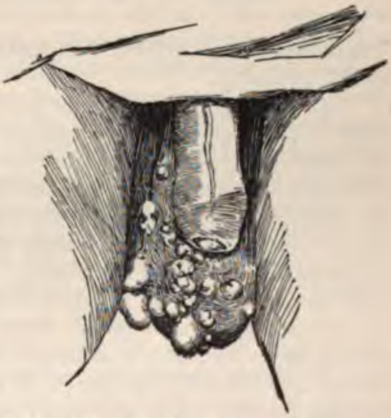

FIG. 174.—Numerous sebaceous cysts of the scrotum from a man æt. forty-five. They had existed many years and most of them were very dense and contained lime salts (drawn by C. H. Freeman).

Serous and hydatid cysts are very rare and may be confounded with vaginal hydrocele; the latter can be diagnosed by the characters of the fluid withdrawn on puncture. Removal is the proper treatment.

Dermoid cysts are sometimes met with (p. 635).

CHAPTER XXVIII

DISEASES OF THE TESTICLES, CORDS, AND VESICULÆ SEMINALES

DISEASES OF THE TESTICLE AND ITS COVERINGS

Anatomy.—Each testicle is suspended in the scrotum by the cord and its coverings.

The epididymis is posterior and consists of an upper enlargement (head or globus major) and the tail or globus minor below, with the intervening body. Just in front of the globus major is a small pedunculated cyst (*hydatid of Morgagni*) which is the remains of the Müllerian duct. The testicle consists of numerous convoluted tubules composed of several layers of flattened epithelium cells and separated by delicate areolar tissue. It is enclosed by a dense fibrous coat (*tunica albuginea*) which posteriorly passes into the gland as an incomplete septum (*mediastinum*), from which radiate delicate fibrous septa which are attached to the tunica albuginea. The tubules are collected together in the anterior part of the mediastinum forming the rete testis, and pass thence as the vasa efferentia to open into the convoluted canal of the epididymis near the globus major. The epididymis becomes the vas deferens beyond the globus minor; this passes along the inguinal canal and to the base of the bladder, where it joins with the vesicula seminalis to form the common duct which opens into the floor of the prostatic urethra.

The nerves of the testis are derived from the renal and aortic plexuses and pass to the organ in company with the spermatic branch of the aorta. The lymphatics are numerous and begin in large spaces between the intertubular connective tissue; they pass to the lumbar glands. The tunica vaginalis will presently be mentioned.

ANOMALIES IN THE DESCENT AND POSITION OF THE TESTICLE

Normal descent.—The testicle is developed within the abdomen from the genital eminence of the Wolffian body; it lies below the kidney and is attached posteriorly by a fold of peritoneum—the mesorchium. The organ subsequently descends into the scrotum, being drawn thither by the gubernaculum testis, which is a composite structure containing muscular tissue. The gubernaculum is attached above to the lower part of the testis and epididymis and below has numerous points of attachment, the most important of which are to the bottom of the scrotum, to the perineum near the anus, to Poupart's ligament in the neighbourhood of the saphenous opening, and on either side of the external ring. Before transit occurs a pouch of peritoneum (*processus vaginalis*) descends into the scrotum, being probably drawn there by the gubernaculum; when the testis passes downwards it lies behind this process which covers its body and the epididymis in front. The processus normally becomes obliterated before birth at the internal ring (so that the abdomen is shut off), and thence to just above the testicle, the lower part remaining as the tunica vaginalis. It sometimes happens that this obliteration of the upper part of the processus does not occur, and in such cases the tunica vaginalis communicates with the peritoneal cavity (see Congenital Hernia, p. 458; Congenital Hydrocele, p. 623). If obliteration is only complete below, *i.e.* just above the testis, the upper part of the processus remains patent, or if the obliteration is only at the internal ring, the tunica vaginalis extends up to this point (see Infantile Hernia, p. 458; Infantile Hydrocele, p. 623).

Lastly, although the processus may be shut off above and below, the intervening portion may be only partially closed, so that cystic spaces result (see Encysted Hydrocele of the Cord, p. 641).

Varieties of malposition of the testis.—The testicle may be **undescended** or **misplaced.** **An undescended testicle** may occupy any part of the track by which it normally passes from the abdomen; thus it may lie close to the kidney, in the iliac fossa, at the internal ring, in the inguinal canal, or close to the upper part of the scrotum at the external ring. The last situation (cruro-scrotal) is the most common. When the testicle has passed beyond the internal ring its situation is easily detected, and it can, to a certain extent, be moved up and down the canal, unless it has become adherent from inflammation. One or both testicles may be undescended, and the tunica vaginalis may be absent or occupy its normal position in the scrotum, in which case a hernia may descend into it, or the sac may become distended with fluid.

Causes of undescended testis.—The causes of non-descent of the testicle no doubt vary in different cases. The organ may be too freely movable owing to a long mesorchium, or may be fixed by adhesions due to intrauterine peritonitis; in the former case descent may or may not occur, in the latter it is impossible. If the gubernaculum testis is absent or weak it will be unable to exercise the necessary traction. An abnormally large testicle or a very small ring and canal may also prevent normal descent. As a rule the vas deferens is long and tortuous, but should it be too short it will necessarily anchor the testicle above the scrotum.

Signs and effects.—The absence of the organ from the scrotum is sufficient evidence that it has not descended, but it does not prove that a swelling which may be felt in the inguinal canal is the testicle, for non-descent may be accompanied by a hernial protrusion into the funicular process; in such a case the swelling would be completely reducible, whereas the testicle, although capable of being moved along the canal, cannot be reduced, or at any rate does not go back in the same characteristic manner as does a hernia. The shape and consistency of the swelling, and in the case of adults, the presence or absence of testicular sensation, will also assist the diagnosis.

A retained testicle is probably at first quite healthy, and provided it be protected from all injury and does not become inflamed, may remain healthy and be functionally active. But in most cases, owing to irritation by muscular contraction, by a truss, or by direct injury, these testicles remain undeveloped and undergo fatty and fibrous degeneration, so that they are functionally useless.

Undescended and misplaced testes are liable to all the pathological conditions which may affect the normally situated organ, but of these inflammation and malignant disease seem to be very prone to occur. Inflammation is usually due to some injury or source of irritation, or may be caused by partial or complete torsion of the cord. An inflamed retained testicle in the inguinal canal may very closely simulate a strangulated hernia, but the vomiting, although sometimes very persistent, does not become fæcal, the absolute constipation and abdominal distension are absent, and the temperature is raised in place of the depression which accompanies the collapse of acute intestinal obstruction; if the testicle is in the scrotum of course no difficulty can arise. In severe cases the testicle may become gangrenous. The treatment of this condition is that to be followed in ordinary epididymo-orchitis, and when the inflammation has subsided, the surgeon must decide upon the propriety of attempting to place the testicle in its normal position, or of performing castration. Inflammation of a testicle still within the abdominal cavity may present great difficulties in diagnosis.

Misplacement of the testicle is dependent upon over-action of certain bands of the gubernaculum testis and is usually unilateral. As a rule the displaced organ is found in the perineum on one side of the raphé, but occasionally it is found on the pubes above the penis, or passes along the crural canal into Scarpa's triangle.

Retroversion of the testicle is occasionally seen, the epididymis and cord lying in front instead of behind the body. It is of no importance except in pathological conditions; thus in hydrocele or hæmatocele the testicle would lie below and in front instead of below and behind, and in cases of enlargement the epididymis might be mistaken for the body and *vice versa.*

Treatment of undescended and misplaced testicle.—The plan of attempting to force a partially descended testicle into the scrotum by the pressure of a truss above it is not to be recommended; it usually fails and is by no means harmless, as it acts as a constant source of irritation, and may excite inflammation. If the testicle is close to the upper part of the scrotum it will often take a lower position as the child grows, or may be gently drawn down every day or so with this end in view.

The testis may be placed in its proper position in the scrotum by **transplantation,** which should be undertaken when the boy is about eight or ten years old, and earlier if the organ is in the perineum, where it is so liable to injury when sitting.

A sufficiently long incision is made to fully expose the testicle, which is then carefully freed from the tissues among which it lies. If the organ is simply undescended, it is now drawn down and placed within the scrotum, being fixed to it as low down as needful by a few points of fine silk suture which must pass through the tunica albuginea. If the funicular process of peritoneum is still patent it should be ligatured above and below, and the intervening portion removed. If the inguinal canal has been opened it must be closed and the ring sutured as in the operation for radical cure of hernia. When the testicle is misplaced, as into the perineum, the incision exposing it must extend into the scrotum to which the organ is stitched.

In those cases in which the testicle has been inflamed, and cannot be transplanted, castration should be performed in order to rid the patient of a functionally useless and often troublesome testicle, which may, moreover, again inflame or become the seat of malignant disease.

ATROPHY OF THE TESTICLE

Causation.—Atrophy of the testicle is a rare sequela of certain morbid conditions. It may follow inflammation of the body or of the epididymis, from whatever cause arising, or may be due to interference with the proper circulation occasioned by varicocele, and occasionally results from the operation for radical cure owing to the inclusion of the spermatic artery in the ligature (see p. 640). Atrophy may also be of nervous origin, and is sometimes consecutive to spinal or head injuries.

Morbid anatomy.—The glandular substance undergoes fatty degeneration and ultimate absorption while the intertubular connective tissue is the seat of sclerosis; the testicle consequently becomes smaller and harder, but in the early stages, before sclerosis is advanced, it is softer than natural. The atrophy is steadily progressive, and the testicle may shrink to the size of a large pea. Bilateral atrophy necessarily causes sterility.

Treatment.—As no known treatment is capable of arresting the progress of the condition, that adopted must have reference to removal of the cause, but even when this is possible it is not usually effective; thus atrophy in connection with varicocele will usually proceed after the veins have been removed by operation.

NEURALGIA OF THE TESTICLE

Etiology.—A variety of causes may give rise to testicular pain, which may be slight or severe; it is usually of a dull aching character, and often extends along the cord to the groin and small of the back. Excessive sexual indulgence or ungratified desire are causes of so-called irritable testis; such a condition is not uncommon at the time of puberty. Renal colic and stone in the kidney, acute or chronic inflammation of the testis or epididymis, varicocele, or a growth are also common causes of pain.

Paroxysms of neuralgia without apparent cause are sometimes experienced.

Treatment.—The treatment must in great measure depend upon the cause. The patient should wear a suspender, and take plenty of outdoor exercise, but must avoid bicycling or riding. The diet should be simple and non-stimulating, and the action of the bowels must be regulated. The severity of the pain may necessitate the use of anodynes, but they should only be given under personal supervision. It is very important to reassure the patient as to his condition, for sexual hypochondriasis is not an uncommon accompaniment. Castration is unjustifiable.

ACUTE ORCHITIS AND EPIDIDYMITIS

Causes.—Inflammation of the body of the testicle or orchitis may complicate epididymitis, or may be the only condition present. The primary affection is not common, but may arise from injury, or as a complication of one of the acute specific diseases, especially mumps, and occasionally as a consequence of gout, rheumatism, or cold. Orchitis in mumps usually sets in about the end of the first week when the initial condition is subsiding; it may consecutively affect both testicles. A retained testicle not uncommonly inflames (see p. 610).

Epididymitis is usually due to backward extension along the vas deferens of gonorrhœal inflammation; it usually occurs about the fourth week of the disease, when the urethritis has reached the prostatic urethra. Epididymitis may also arise from urethral irritation excited by the passage of instruments or a calculus, and comes on within a few hours.

Morbid anatomy.—In orchitis the body of the testicle is uniformly enlarged by inflammatory effusion into the intertubular connective tissue. Acute inflammation of the tunica vaginalis commonly occurs, and this occasions an inflammatory exudation into the sac, which is, however, rarely copious (*acute inflammatory hydrocele*).

In epididymitis the epididymis is much swollen, and forms a large crescent posteriorly which may almost conceal the body of the testicle; the swelling is increased by effusion into the surrounding cellular tissue, and the inflammation may extend to the body of the testis. The epithelium of the tubules degenerates, and is cast off into the lumen. The vas is congested, swollen, and in a state of catarrh, and cellulitis may extend up the cord.

Acute inflammation of the testis or epididymis often causes considerable effusion into the cellular tissue of the scrotum with consequent œdema. The veins are engorged, and in some cases may be thrombosed.

Signs.—The onset is sudden, and accompanied by severe sickening pain in the testicle, which extends along the cord to the groin and loin. The testis is acutely tender, and the pain is increased if the organ be not supported. The enlargement of the testis or epididymis may be apparently greater than it really is, owing to the presence of fluid in the tunica vaginalis or œdema of the cellular tissue. The scrotum is œdematous and red, and engorged veins are to be seen coursing beneath the skin. In epididymitis the vas deferens—indeed the whole cord—is tender, and if the inflammation be consecutive to gonorrhœa the discharge ceases or is considerably diminished with its onset, but it almost invariably returns when the epididymitis subsides.

The constitutional symptoms vary in severity; in bad cases the patient may have an initial chill, or even a slight rigor, and the temperature may reach 104° or 105° F.; he looks and feels very ill, and may be troubled by vomiting. In other cases the temperature is only raised about 2° F., and the constitutional symptoms are comparatively mild.

Course and prognosis.—The acute stage usually subsides in about a week, and the inflamed part becomes less tender and harder. The swelling gradually subsides, but many weeks may elapse before complete resolution occurs; sometimes the inflammation becomes chronic, and the testis or epididymis remains indurated and enlarged.

Suppuration and even gangrene occasionally occurs, and is more likely to do so if the inflammation accompanies one of the acute infective diseases.

Epididymitis may result in blocking of the seminal ducts by inflammatory effusion, with consequent sterility if both organs are affected.

Atrophy of the testicle is an occasional sequela, but is much rarer than is commonly supposed; it is perhaps more frequently seen after mumps. Gonorrhœal epididymitis is occasionally complicated by vesiculitis, and extension of the inflammation along the cord has been known to induce pelvic cellulitis and peritonitis.

Gouty and rheumatic orchitis are very persistent, and are liable to recur and become chronic; these conditions are often complicated with other manifestations of the diathesis.

Treatment.—Complete rest in bed with the scrotum raised on a pincushion or folded towel is essential. If the case is seen within the first few hours the continual application of an ice-bag will afford great relief and cut short the inflammation, but at a later stage hot fomentations will prove more serviceable and soothing. If the inflammation is very acute, the pain great, the constitutional symptoms severe, and the patient young and strong, considerable benefit will result from puncturing the engorged scrotal veins, the bleeding being encouraged by bathing the scrotum with hot water, or the employment of hot fomentations. Painting the scrotum with collodion, or with a solution (ʒi. ad ℥i.) of silver nitrate, also gives relief in some cases; if the latter is used, care must be taken that vesication is not produced. When there is a considerable amount of fluid in the tunica vaginalis causing an increase of the pain, this should be drawn off by a fine trocar. The plan of puncturing the testicle is not to be recommended.

In gonorrhœal epididymitis, urethral medication must be suspended.

Gouty and rheumatic orchitis must, in addition to the local treatment, receive that employed in these diatheses.

As regards the general treatment, the diet must be of a fluid nature during the acute stage of the inflammation, but in view of the depressing nature of the malady it should be liberal and generous as soon as the fever and inflammation have subsided.

When resolution is in progress, the treatment recommended for simple chronic orchitis should be employed. Should suppuration occur the pus must be evacuated, and if the organ is disorganised castration should be subsequently performed.

SIMPLE CHRONIC ORCHITIS AND EPIDIDYMITIS

Chronic orchitis and epididymitis may follow on the acute form, or may result from some long-continued source of irritation in the urethra, especially such as necessitates the habitual use of instruments, *e.g.* enlarged prostate. In one case under my care a gentleman, who had habitually used the catheter for some years, had double epididymo-orchitis resulting in chronic abscess.

Morbid anatomy.—The testicle or epididymis, or both, are considerably enlarged and hardened by an increase of the intertubular connective tissue. The epithelium of the tubules degenerates, and the tubules atrophy from pressure. Chronic hydrocele is common, and suppuration may occur.

Signs.—When the body is the part affected, the signs are similar to those of syphilitic testicle. In chronic epididymitis the part is enlarged and hard, especially at the globus minor, and the cord may also be implicated; the condition simulates tubercular disease, but the enlargement is more uniform, and does not tend to soften and break down, nor are there other evidences of tubercular mischief.

Treatment.—Any source of urethral irritation must be removed or reduced to a minimum. The testicle may be strapped with mercury plaster, and a suspender should be constantly worn. Small doses of the perchloride of mercury, in combination with iodide of potassium and vegetable bitters, should be persevered with, and frequently cause rapid resolution. The diet should be generous, and change of air is advisable in persistent cases.

ABSCESS OF THE TESTICLE AND EPIDIDYMIS

Causes.—Suppuration occurring in the testicle and epididymis is rare, except in cases of tubercular disease. Acute abscess may occur from a variety of causes, but its occurrence is certainly predisposed to by a condition of general ill-health in addition to the actual exciting cause; it may or may not be associated with suppuration in the tunica vaginalis, and is often accompanied by extensive sloughing of the testicle and its ultimate complete disorganisation and destruction. Acute abscess may be met with as the result of injury of the organ or instrumental irritation of the urethra, of stricture, or in association with gonorrhœal inflammation, general septic infection, or one of the acute specific diseases, especially typhoid or smallpox.

Chronic suppuration is usually due to the breaking down of tubercular foci in the epididymis, or to syphilitic inflammation of the body of the testis; it occasionally occurs as the result of chronic urethritis due to habitual instrumentation of the urethra.

Signs and results.—Acute suppuration is preceded by the local and constitutional symptoms of acute epididymo-orchitis, but with the advent of suppuration these become more marked, and the pain may be very intense; fluctuation may be detected, especially if there is pus in the tunica vaginalis. Unless the pus is evacuated the abscess bursts upon the surface, and sloughy portions of the testicular substance come away with the discharge. In the least severe cases the abscess cavity will gradually close, but in many the organ is destroyed, and fungus testis results.

In chronic cases the signs are less suggestive, but the occurrence of suppuration will be evident by the gradual softening of the inflammatory products with involvement of the skin and signs of fluctuation.

Treatment.—As soon as pus is diagnosed, it must be evacuated through a moderate incision, and the case treated on ordinary principles. If the testicle is much disorganised or fungus results, castration should be performed as soon as the acute inflammation has subsided.

Tubercular cases call for castration.

Abscess in connection with syphilis must be treated by anti-syphilitic remedies.

SYPHILITIC TESTICLE

Morbid anatomy.—The disease may be limited to one testicle, or both may be consecutively affected. Tertiary syphilis affects the body of the testicle, but very rarely the epididymis. It causes general chronic inflammation (diffuse form), which is often more pronounced at certain places (gummatous form). In congenital syphilis the diffused form is the more usual, but gummata may also be present. The inflammation attacks the fibrous septa, the tunics, and the intertubular connective tissue, all of which are much thickened, and dense bands of fibrous tissue radiate from the mediastinum testis. The sac of the tunica vaginalis is usually distended with fluid, which, however, often becomes partly or completely absorbed in the latter stages of the mischief, and adhesions may obliterate the sac or render the hydrocele loculated (Fig. 175). The greater intensity of the inflammation at certain spots gives rise to the formation of gummata, which are separated by the thickened septa or fused together.

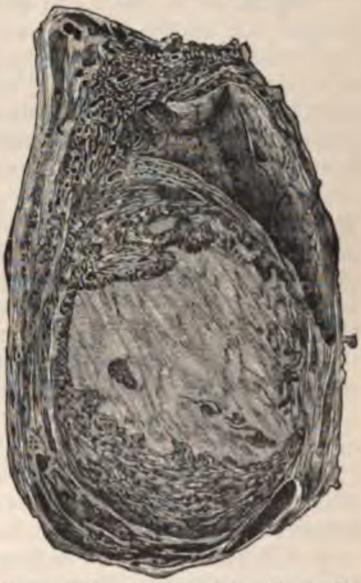

FIG. 175.—Gummatous orchitis. The testicle was enlarged to three times its normal size. The body is largely occupied by a mass of tough, homogeneous, yellow, gummatous material, in the midst of which patches of gland tissue remain. Bands of organised lymph pass between the opposite layers of the tunica vaginalis. The epididymis is unaffected. The specimen was from a sailor subject to enlargement of both testicles for three years. He had no trace of syphilis. After removal of the specimen the other testicle returned to its normal size (Jacobson, Diseases of Male Organs of Generation).

Gummata are of a pale yellow colour and are poorly vascularised owing to syphilitic endo-arteritis of the vessels, although they are surrounded by a hyperæmic zone. They vary considerably in size, and as they are usually situated in the centre of the body the testicle is uniformly enlarged, although it may be nodular. In consequence of their low vascularity the gummata tend to break down and burst on the surface, unless this be prevented by early treatment. Fungus testis occasionally results. In consequence of the pressure exercised upon the tubules by the new inflammatory tissue the secreting structure of the gland undergoes fatty degeneration and ultimate absorption, with a corresponding diminution of the functional activity of the organ.

Signs.—The onset and progress of syphilitic orchitis are very gradual and usually unaccompanied by pain, although there may be some discomfort and weight from dragging on the cord. The body of the testicle is hard, heavy, and uniformly enlarged, but bossing may be present if the gummata are near the surface. The epididymis, cord, prostate, and vesiculæ seminales remain healthy, but in rare cases the first may be implicated.

Hydrocele is nearly always present in the early stages, but the fluid tends to become absorbed. Testicular sensation is present at first, but gradually diminishes and is finally abolished as the glandular structure is destroyed. Sexual desire and power similarly decrease, and if both testicles are affected they may be completely lost.

If the gummata break down softening can be detected. The skin inflames and becomes adherent to the softened patch which ultimately discharges upon the surface, leaving a more or less rounded crater-like cavity.

The diagnosis of syphilitic testicle is usually easy. The history and probably other evidences of syphilis, the gradual and apparently causeless occurrence of the trouble and the association of the orchitis with hydrocele being the leading diagnostic features. From simple chronic orchitis the diagnosis can in most cases only be made by trying the effects of treatment. Tumours of the testicle may be diagnosed by their more rapid and steadily progressive growth, by their tendency to spread to the epididymis, by the absence of hydrocele, and by the fact that the mischief is practically never bilateral. Tubercular disease originates in, and is usually limited to, the epididymis, but tends to spread to the prostate and vesiculæ seminales.

Treatment.—The treatment consists in suspending the testicle, which may be strapped with mercury plaster, and the internal administration of iodide of potassium in gradually increasing doses with small doses of the perchloride of mercury. The diet must be plentiful and the general health of the patient improved by change of air and tonics.

If a hydrocele is present it should be tapped, not so much as a curative measure as to enable the surgeon to thoroughly examine the testis. The sac must never be injected.

If the gummata break down and discharge on the surface healing will usually readily occur under treatment, but in those cases in which the testicle is seriously disorganised it should be removed, as it is functionally useless and may be a source of annoyance to its possessor.

TUBERCULAR TESTICLE

Causes.—Tubercular epididymitis usually occurs in young adults, but may be met with in children and older patients. It is sometimes the starting-point of widespread tuberculosis of the genito-urinary tract; more rarely it is secondary to disease originating in the kidney or bladder, and pulmonary phthisis may or may not be present. The tubercle bacillus is brought to the epididymis by the blood stream, and probably previous injury or gonorrhœal inflammation must be regarded as predisposing causes by lowering the resistance of the tissues. It seems probable also that the epididymis is attacked in preference to the body of the testicle owing to the lodgment of the bacillus being favoured by the vascular distribution.

It is suggested by some that the bacilli may in some cases gain entrance from the urethra and spread directly to the epididymis by the vas, and, moreover, that the organisms may find their way into the urethra by direct inoculation from a tubercular uterus during coitus. There is no actual proof in support of these suggestions.

Morbid anatomy.—The disease begins in the head or tail of the epididymis, more usually the latter, and spreads through the body to the vas deferens, the testicle, and the connective tissue surrounding the epididymis. There is round-celled infiltration and the formation of typical tubercular nodules in the intertubular connective tissue, and very soon the tubules themselves are affected, the walls being thickened and the lumen occluded by proliferated and degenerated epithelium. Caseation and softening of the tuberculous tissue ultimately results, and by the coalescence of adjacent foci of disease and by gradual invasion large caseous tracts are developed which burst upon the surface. As the disease extends along the vas this becomes thickened and its lumen obstructed by caseous tubercle. Here and there along its course the disease may be more marked, so that the vas feels nodular. Extension to the vesiculæ, prostate, bladder, and higher urinary tract will ultimately result.

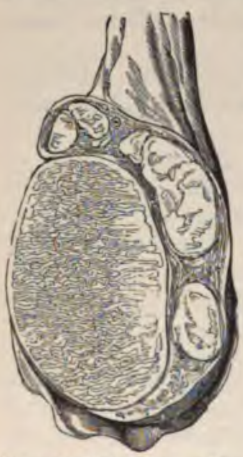

FIG. 176.—Tubercular epididymitis. Masses of tubercular origin mixed with lime salts are present in the epididymis; the body of the testis is apparently healthy (Curling).

The tubercular process also extends through the rete testis to the body of the organ, and when this has occurred hydrocele may be present, or the tunica vaginalis may become tubercular or be more or less obliterated by adhesions. Fungus testis occasionally results (Fig. 178, p. 622).

Signs.—The onset and general progress of the disease is insidious and painless. The condition of the epididymis is often only recognised accidentally. It will be found, especially near the globus minor, to be enlarged, hard, nodular, or craggy, and at first quite circumscribed. The enlargement of the epididymis is further accentuated by some degree of chronic inflammation of its capsule and the surrounding connective tissue, and it may be so great as to conceal the, as yet, unaffected body of the testis.

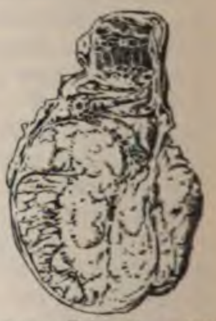

FIG. 177.—Tubercular epididymitis. The epididymis is much enlarged and caseous, and a piece of skin is adherent to it behind. The body of the testicle is flattened and atrophied (Westminster Hospital Museum, No. 1010. Drawn by C. H. Freeman).

Sooner or later softening and suppuration occur. The softened patch becomes adherent to the reddened and perhaps œdematous skin, which soon becomes riddled with sinuses discharging curdy pus.

The vas deferens will be found thickened. Rectal examination may reveal the fact of extension to the prostate or vesiculæ, these parts being felt enlarged, clearly outlined, and dense, unless softening has already occurred. Hydrocele is occasionally, though rarely, present.

The general health of the patient may be good, but he is generally pale and out of health, especially if the kidneys or lungs are affected.

Diagnosis.—The condition most likely to be confounded with tubercular epididymitis is simple chronic inflammation due to antecedent gonorrhœa or to some chronic source of urethral irritation. The simple inflammation is usually more uniform than, and wants the nodular outline of, tubercular disease. The vas deferens, prostate, and vesiculæ will usually be found healthy, as will the kidneys and lungs. Moreover, while tubercle has a special tendency to caseation and softening, this is not met with in the simple chronic inflammation.

Prognosis.—Tuberculous epididymitis is a most grave condition, being, as it is, so frequently associated with pulmonary phthisis or with tubercle of the rest of the genito-urinary tract. In cases where the tubercle is strictly limited to the epididymis or body it can be completely eradicated by castration. Consecutive invasion of both testicles is by no means rare. If there is definite evidence of involvement of the prostate and vesiculæ the prognosis is extremely bad, although the patient may live for some time.

Treatment.—The practice of laying open and sharp-spooning the caseous patches in the epididymis appear to me to be bad, for it is more than likely that only the most advanced patches of disease are attacked, and that continued invasion will occur. Moreover, such a rough procedure as sharp-spooning a structure like the epididymis must so much impair, if it does not actually destroy, its anatomical integrity as to render it functionally useless.

As soon as it is certain that the condition is tubercular castration should be at once performed, the cord being divided well above the disease. The inguinal canal must be opened up for this purpose if necessary. Any involved skin must also be cut away.

If the higher genito-urinary tract is undoubtedly diseased, or pulmonary phthisis or any other tubercular mischief is present, the propriety of resorting to castration must be determined on the merits of the case. There is no doubt that removal of a diseased testis which is causing the patient annoyance and is perpetually discharging purulent material through unhealthy sinuses may be followed by a considerable improvement in the general health, and may thus materially benefit phthisis or any other tubercular condition, but at the same time, if such disease is advanced beyond hope of cure, few surgeons would contemplate the removal of a tubercular testicle.

HERNIA OR FUNGUS TESTIS

As the result of destructive disease the testis may protrude through an opening in the skin. The disease is nearly always syphilis or tubercle, especially the latter, but occasionally chronic inflammation and suppuration occurring independently of these conditions may be responsible for the fungus. A fungating new growth is not usually described as hernia testis.

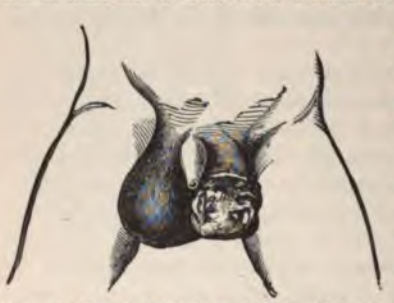
FIG. 178.—Hernia testis in an infant. The condition was probably tubercular (Curling).

The fungus chiefly consists of granulation tissue, with only a small amount of testicular substance in its deeper parts; it is usually rounded in shape, and its margins overlap the opening in the skin, so that the mass is mushroom-shaped. The opening in the superficial structures (which are intimately adherent to the inflamed organ) is rounded and its margins are indurated; small sinuses may also perforate the skin. The testicle may be considerably enlarged as the result of the pathological process of which it is the seat, but sometimes it appears small, since the greater part of it has passed outside the scrotum.

Treatment.—Castration is the most appropriate treatment and is essential in tubercular cases. When the fungus is due to syphilis and is quite small a cure may be effected by the use of iodides internally and mercurial strapping. But even in such cases the advantage of the cure is doubtful, since it is probable that the testicle is totally disorganised and the patient loses nothing and is more rapidly freed of his trouble by castration. The method of shaving off the fungus, freshening the edges of the skin and bringing them together does not offer any special advantages, and is, moreover, very likely to fail in its object.

HYDROCELE OF THE TUNICA VAGINALIS

Varieties.—Distension of the tunica vaginalis by serous fluid is known as hydrocele. The following varieties are met with:—

Simple hydrocele.—The fluid is contained within the serous sac which is normally formed. Such a hydrocele may occur as the only morbid condition. It is then said to be *primary*, but if it is due to some other pathological state such as syphilitic orchitis it is called *secondary*. When the accumulation of fluid is rapid and secondary to inflammation of the sac or of the testicle *acute hydrocele* results. *Hydrocele en bissac* is the term applied to that form in which the sac is hour-glass in shape and the upper part extends upwards towards or on to the abdominal wall.

Congenital hydrocele.—The processus ad testem is patent and the tunica vaginalis communicates with the general peritoneal cavity (p. 609).

Infantile hydrocele.—The processus is shut off at the internal ring but communicates with the tunica vaginalis below (p. 609).

Causes.—Acute and secondary hydroceles are dependent upon injury or inflammation of the testicle, epididymis, or tunica vaginalis as the result of gonorrhœa, syphilis, the acute infective diseases, rheumatism, or any other cause. Acute hydrocele is a common accompaniment of elephantiasis scroti (p. 99). The etiology of the ordinary chronic hydrocele is obscure. It often occurs in infants and becomes increasingly common after forty years of age. Some regard the condition as being essentially inflammatory, while others attribute it to simple dropsy; many arguments may be adduced for and against either view, but the balance of evidence is in favour of an inflammatory origin (Fig. 179). Hydrocele is more common in hot than in temperate climates, and is said by some to arise in association with malaria.

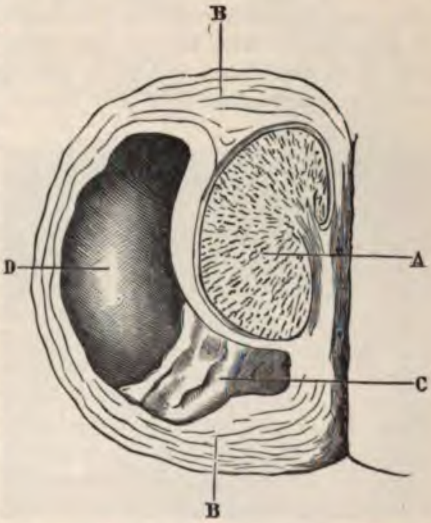

FIG. 179.—Chronic vaginalitis with a hydrocele. *A*, testicle; *B*, thickened tunica vaginalis; *C*, septum of the thickened wall; *D*, cavity of the hydrocele (Follin).

Morbid anatomy.—Hydrocele fluid is usually quite clear and of a pale straw colour; there is no deposit on standing, it is neutral in reaction, has a specific gravity of about 1020, and is not spontaneously coagulable, but coagulates on heating or after admixture with blood serum. It contains about 6 per cent of albumen, fibrinogen, and some cholesterine. The fluid may be bloody and is occasionally like cocoa-nut milk; this milky character may be due to admixture with fat which has escaped from the altered vessel walls or to lymphangitis; the hydroceles met with in elephantiasis contain chylous fluid (see p. 100).

The quantity of fluid varies much, but in ordinary cases averages about eight to ten ounces.

In recent cases the wall of the sac is stretched, thin, and translucent, but when the condition is of long standing it becomes considerably thickened and dense, and may actually calcify; in some cases false membranes, of inflammatory origin, may line the interior.

The cavity of a hydrocele is usually single and pyriform with the apex upwards, but sometimes it is multilocular owing to the presence of adhesions. The testicle lies below and behind and remains practically unchanged except in old cases in which the long-continued pressure of the fluid may lead to fatty atrophy and sclerosis. If the testicle be retroverted it will lie below and in front of the fluid—a point to be remembered and ascertained before a hydrocele is tapped.

Signs.—An acute hydrocele is rarely large, does not assume the ordinary clinical character about to be described, and usually subsides quickly with the cessation of its cause.

The ordinary vaginal hydrocele very slowly increases in size without causing pain; the enlargement which it occasions is first noted at the lower part of the scrotum. The tumour is pyriform in shape with the apex upwards but does not extend into the canal, except in the congenital and infantile forms. There is no impulse on coughing, and distinct fluctuation is usually present. Most hydroceles are translucent, but this sign may be

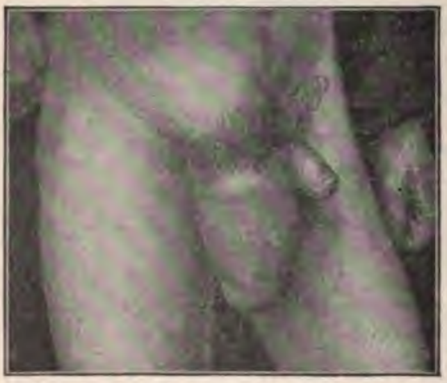
FIG. 180.—Large hydrocele of the tunica vaginalis (Keen and White).

absent either because the wall of the sac is dense and thickened, or because the fluid has been rendered opaque by admixture with blood or from some other cause.

A hydrocele is intimately connected with the testicle which can be made out in the position already mentioned, but cannot be isolated from the tumour. When a hydrocele attains a large size the penis may be completely hidden, the orifice of the prepuce appearing at the upper part of the scrotum and looking like the umbilicus. Pain is absent, but owing to the weight of the sac the patient may experience dragging and discomfort about the groins and loins.

Diagnosis.—An ordinary hydrocele can usually be readily diagnosed by attention to the following points:—Its slow, painless growth from below upwards; the freedom of the external abdominal ring; the fluctuation and translucency of the tumour and absence of impulse on coughing.

Under some circumstances, however, difficulties will be encountered. The association of hydrocele with hernia is by no means uncommon, and if the latter be irreducible the existence of the hydrocele below may be overlooked (Fig. 181). A congenital hydrocele may extend up into the canal, but it is slowly reducible without the characteristic slip and gurgle which indicates the reduction of a hernia, and when the patient assumes the erect posture the sac slowly refills. Infantile hydrocele similarly extends to the canal, but is not reducible; both these forms are readily translucent.

When the sac wall is very dense and hard and translucency is absent the condition may be confounded with hæmatocele or new growth of the testicle, and an exploratory puncture may be necessary to clear up the diagnosis.

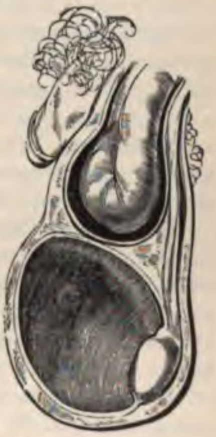
FIG. 181.—The ordinary relations of a vaginal hydrocele and scrotal hernia (Curling).

Course and prognosis.—An acute inflammatory hydrocele rarely attains a large size, and on the subsidence of the inflammation is soon absorbed, the cavity of the sac being more or less obliterated by adhesions; sometimes, however, the fluid effusion remains and chronic hydrocele results.

Hydroceles which are secondary to some acute infective disease may suppurate. When the primary condition is some chronic mischief in the testicle, *e.g.* syphilis, the fluid accumulation is usually small and in time often tends to become absorbed and adhesions form between the parietal and visceral layers of the tunica vaginalis (p. 617).

Simple hydrocele in infants is usually easily curable by simple puncture, but in adults such a happy event is of great rarity.

It occasionally happens that, as the result of injury, a hydrocele ruptures and the fluid is effused into the scrotum; such an event leads to considerable œdema and bruising, but as the fluid becomes absorbed spontaneous cure may result; in other cases suppuration may ensue. Injury may also lead to the effusion of blood into the sac (*hæmatocele*).

Treatment.—The treatment must vary according to the nature of the hydrocele and circumstances of the case.

Inflammatory hydroceles should only be tapped if the fluid accumulation is considerable and causes much pain; under other circumstances absorption soon occurs as the primary inflammation subsides.

Secondary hydroceles when of sufficient size to obscure the testicle and prevent its thorough examination should always be tapped, but must never be submitted to any other form of treatment.

Infantile hydrocele is most successfully treated by acupuncture; the skin should be made tense and the sac punctured in several places with an ordinary sewing needle; the fluid escapes partly on the surface but mainly into the scrotal tissues. Cure may be effected at one sitting, but usually more are required at intervals of about a week.

Congenital hydrocele may, after a truss has been applied to the canal, be cured by acupuncture or tapping, and even injection of carbolic acid may be employed, but it must be carefully performed in view of the connection of the sac with the general peritoneal cavity and the possible excitation of acute peritonitis. When adhesions occur as the result of treatment the processus is obliterated. Finally the processus may be cut down upon, ligatured in two places, and divided as in the radical operation for congenital hernia.

Simple hydrocele may be subjected to treatment by tapping, the injection of iodine or carbolic acid or by excision of the sac; other means have been practised, but since they are practically obsolete they will not be considered here.

Tapping is a palliative rather than a curative measure, for the fluid almost invariably re-accumulates in a few weeks or months and must be again removed. The scrotum should be shaved and thoroughly cleansed, and every care must be taken that no septic material is introduced by the trocar. The surgeon grasps the scrotum in one hand and making the skin tense thrusts a fine trocar and canula into the sac at a place free from large veins; he prevents the needle going too far by placing his finger on it about one inch from the end, and thus all danger of wounding the testicle (the position of which must be previously ascertained) is avoided. As soon as the sac has been entered, the trocar is turned upwards and withdrawn, the fluid then escapes by the canula. The small puncture should be covered with antiseptic wool and collodion, and the patient should wear a suspender.

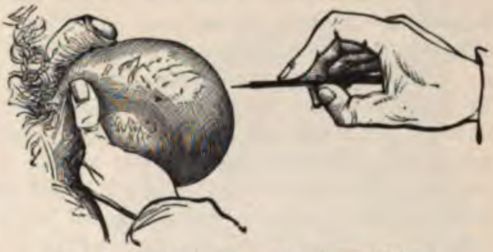

FIG. 182.—Method of tapping a hydrocele (Osborn).

If the testis be accidentally punctured it occasions extreme sickening pain, which, however, soon passes off, and no ill effects follow. It sometimes happens that hæmatocele results from puncturing a hydrocele either because a vessel has been wounded by the trocar, or because spontaneous rupture of a vessel has occurred as the fluid support has been removed.

Tapping and injection with tincture of iodine or pure carbolic acid liquefied with glycerine is a simple, safe, and usually successful method of radical cure. Carbolic acid is certainly preferable to iodine; it causes less pain, is more certain in its results, and accomplishes the purpose more quickly, so that the patient is usually able to get about again in three or four days, whereas iodine often incapacitates him for a week or more.

Injection with carbolic acid is performed as follows:—

The sac is completely emptied by tapping, and about two drachms of the glycerine solution is then injected through the canula. The sac should be gently kneaded to ensure the fluid coming in contact with all parts of it, and in about five minutes half of it is withdrawn, the canula is removed and the puncture closed with antiseptic wool and collodion. If the patient is very nervous, a little 5 per cent cocaine solution may be thrown into the sac after tapping; this is withdrawn in five or ten minutes and the carbolic is then injected. In a few hours slight reactionary inflammation will be present, but this soon subsides if the patient be kept at perfect rest with the scrotum raised, and in three or four days he may get up and about, the scrotum being supported by a suspender.

Injection may fail if the fluid used is too dilute, and it may then require repetition or the sac may be excised. Occasionally suppuration results, necessitating free incision of the sac.

Excision of the sac is applicable to cases in which injection fails to produce a cure, or the sac wall is dense and thickened. The strictest antiseptic precautions must of course be adopted. The sac is laid open and the redundant portion is carefully isolated and cut away, the surface of that which is left being swabbed over with carbolic acid and glycerine. The cut edges of the sac are then carefully united with chromic gut and the skin wound is closed, the lower part being drained for a few days.

Healing should be complete in a week, and the patient, wearing a suspender, may get about by the tenth day.

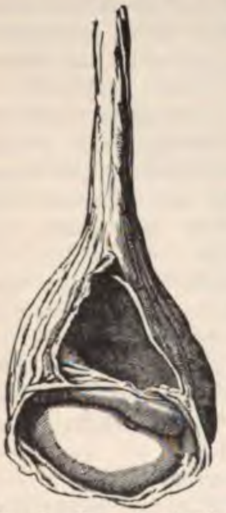

FIG. 183.—Encysted hydrocele. The cyst is above the testicle, which is so displaced by it that its anterior edge is directed downwards (Curling, Specimen in London Hospital Museum).

ENCYSTED HYDROCELE OF THE TESTIS AND EPIDIDYMIS

Anatomy. — Encysted hydrocele is a very rare condition of the testis, but it is not uncommon in connection with the epididymis. In the former situation the cyst is quite small and is situated close beneath the tunica albuginea; it probably arises by dilatation of a tubule. Encysted hydrocele of the epididymis may arise in one of the following ways:—

(1) By dilatation of the hydatid of Morgagni, which is a remnant of the Müllerian duct. It forms a small pedunculated cyst about the size of a currant (under normal conditions) situated at the free extremity of the globus major between it and the testicle.

(2) As the result of dilatation or rupture of a tubule of the rete testis.

(3) By dilatation of a tubule of the epididymis, especially in those in advancing life (Fig. 184). Such cysts are considered by some as analogous to the involution cysts of the breast (p. 671).

(4) By dilatation of the organ of Giraldés which is a remnant of the Wolffian body, and consists of several convoluted tubes lined with ciliated epithelium which are situated in front of the cord close to the globus major.

(5) By dilatation of the vas aberrans of Haller. This is a closely convoluted coiled tube about a foot in length, which is connected with the lower end of the epididymis, and lies between it and the vas deferens.

(6) By dilatation of the lymph spaces.

An encysted hydrocele contains fluid which varies in appearance and composition according to its mode of origin. Thus the fluid may be clear and serous or opalescent and milky and contain living and dead spermatozoa (*spermatocele*).

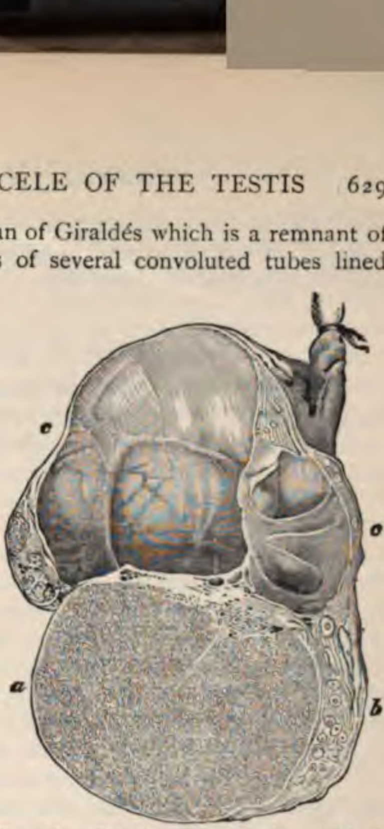

FIG. 184.—Retention cysts in the epididymis (Ziegler). *a*, testis; *b*, epididymis; *c*, cysts.

Signs.—Encysted hydroceles grow very slowly without pain and are usually discovered accidentally. They rarely attain a size larger than that of a walnut; the largest originate in connection with the globus major. A sudden increase in size may result from injury causing hæmorrhage into the cyst (*encysted hæmatocele*). The cyst is usually very tense, and hence may appear to be solid; as a rule it is translucent. It moves with the testis and cord, but not independently of them. If the cyst is multilocular it may be irregular in outline, but it is usually rounded or ovoid.

Treatment.—If the cyst is small and causes no inconvenience, no treatment is really necessary.

If a radical cure is undertaken the choice lies between tapping and injection or antiseptic incision. Injection is performed in the same way as for hydrocele of the tunica vaginalis, but the fluid should be about half the strength recommended to be used for that condition (p. 627). This method of treatment is very uncertain, and should it fail antiseptic incision must be resorted to; when the fluid has been evacuated the interior of the cyst should be swabbed over with carbolic glycerine solution and the wound closed. If the sac is large part of it may be removed with advantage, and drainage may be employed for a few days.

HÆMATOCELE OF THE TUNICA VAGINALIS

Causes.—An effusion of blood into the sac of the tunica vaginalis is almost invariably due to injury, but it may occasionally occur spontaneously, as in hæmophilia, scurvy, and similar conditions, and also in association with malignant disease of the testicle.

Some are of opinion that hæmatocele is always preceded by inflammation of the tunica vaginalis, resulting in the formation of false vascular membranes which are the source of profuse bleeding even on slight injury (*hæmorrhagic vaginalitis*); this view, similar to that held with regard to the blood cysts of the cerebral membranes, is undoubtedly supported by facts in many cases, but not in all. Hæmotocele is met with in association with hydrocele, and may be caused by injury of a vessel during tapping or by its rupture after the withdrawal of the fluid; it may also be due to a blow.

Hæmatocele is extremely rare in the young.

Morbid anatomy.—The condition of the blood varies with the age of the hæmatocele and the rapidity of its formation. At first the blood is fluid, but it soon coagulates except quite in the centre, where it is of tarry consistency and appearance and contains a considerable quantity of cholesterine. The outermost portion of the clot may, especially if the effusion took place slowly, be distinctly laminated so as to resemble that met with in an aneurismal sac. As coagulation of the blood takes place some of the serum becomes absorbed, and hence the swelling becomes smaller and harder.

The tunica vaginalis becomes thickened by chronic inflammation, and is sometimes lined by vascularised false membrane; it may be calcareous. The thickening may be so great that the swelling appears to be solid. Suppuration of the sac occasionally occurs. The testicle occupies the same position as in cases of hydrocele (see p. 624), and may undergo atrophy from pressure.

Signs.—The rapidity with which the effusion occurs varies with circumstances; it may be very slow and continue for a considerable period, or, as in the occurrence of bleeding into the already distended sac of a hydrocele, it may be rapid.

There is a history of injury quickly followed by swelling which gradually increases in size accompanied by considerable pain, especially if the injury has also excited orchitis. The scrotal tissues may also have been bruised, though this may not appear for some days. The swelling is limited by the tunica vaginalis and forms a pyriform or rounded tumour which masks the testicle, the presence of which can, however, be ascertained by the sensation given to the patient when it is pressed upon by the finger. The tumour is heavy and opaque; at first it is elastic and may distinctly fluctuate, but as the blood coagulates it becomes denser, harder, and somewhat smaller. The cord is not affected.

Diagnosis.—The general diagnosis is the same as that for hydrocele, from which hæmatocele may be distinguished by the history of an injury rapidly succeeded by swelling, by the more rounded shape of the tumour, and by its greater weight and want of translucency. In old cases, especially such as form slowly, the diagnosis from a new growth of the testicle may be extremely difficult, for in both cases there may be a traumatic history; if there is any doubt, an exploratory puncture or incision must always be made before castration is performed; if a hæmatocele is punctured, dark altered blood will escape and the flow will continue for some time. Involvement of the cord is in favour of new growth, but if the patient is certain that the enlargement has decreased in size and become harder since he first noticed it, the diagnosis of hæmatocele is almost certain.

Treatment.—With the onset of the bleeding the patient must be kept at rest; the scrotum should be raised, and an ice-bag continuously applied. The bowels must be opened and kept acting by saline aperients. If the effusion is small in quantity absorption may gradually ensue and may be more or less complete, but should this not occur the fluid part of the blood may be drawn off through a trocar. This must not, however, be done during the early stages of the trouble, for if the vessel from which the bleeding took place is not obliterated, it will, on removal of the pressure which the effused blood exercises upon it, bleed afresh. If absorption does not occur and tapping is not followed by cure, antiseptic incision and evacuation of the clot and false membranes, if any are present, is the appropriate treatment. In old-standing cases, especially if the walls are much thickened, calcareous, and lined by tough false membrane, and if the testis is atrophied, castration should be performed.

Suppuration is accompanied by all the local and constitutional signs of acute abscess and must be treated on the same lines, the blood clot being turned out after incision of the sac.

ENCYSTED HÆMATOCELE OF THE TESTICLE AND EPIDIDYMIS

This condition is due to hæmorrhage into an encysted hydrocele as the result of injury. If the existence of the hydrocele was known the patient will be in a position to state that after the injury it suddenly increased in size. Encysted hæmatoceles occasionally assume a large size and may more or less conceal the testicle which lies in front of the tumour.

Treatment.—The treatment is the same as for hæmatocele of the tunica vaginalis.

PARENCHYMATOUS HÆMATOCELE OF THE TESTICLE

This is an extremely rare condition and consists in hæmorrhage into the body of the testicle as the result of injury. The patient is seized with sudden acute pain and the testicle enlarges so that the case may superficially resemble one of orchitis; but the absence of temperature and constitutional symptoms and the history of injury will serve to confirm the diagnosis. Fluctuation cannot be detected, but an exploratory puncture will draw off fluid blood. Under treatment by rest and ice absorption usually occurs, but if the hæmorrhage is large or suppuration occurs so that the testicle becomes disorganised, castration is indicated.

TUMOURS OF THE TESTICLE

Innocent connective-tissue tumours of the testicle are very rare; fibromata and enchondromata are occasionally met with. **Fibromata** may originate in the tunica albuginea and only implicate the testicle by pressure, or they may grow in connection with the rete testis; sometimes they are mixed with unstriped muscular tissue.

Pure **enchondroma** is very rare, and may be preceded by some distinct injury. Virchow considers that the cartilage growth is the outcome of some formative process analogous to the formation of callus, and arising in consequence of some antecedent inflammation. Mixed cartilaginous tumours are more frequently met with, and will be referred to in connection with sarcoma and cystic disease.

Signs.—Innocent tumours of the testicle grow very slowly and painlessly. They do not affect the cord or skin, nor do they produce secondary deposits. The outline is at first smooth and uniform, but may become bossy. The growth is very heavy.

Treatment.—Castration is the only available treatment.

CYSTIC DISEASE OF THE TESTICLE

The term cystic disease of the testicle is applied to pathological conditions of the organ not by any means always identical or running the same clinical course, but always associated with the development of cysts. Eve describes two varieties—**cystic fibroma** and **cystic sarcoma**—between which, however, there may be intermediary forms of growth, and in this respect the conditions may be somewhat aptly compared with those tumours of the breast in which fibrous, sarcomatous, and glandular elements may be combined with cysts (Fig. 185), so that many different tumours will result (p. 677).

These tumours originate in the rete testis and gradually flatten out and compress the body of the testicle in front of them. Eve thinks that the cysts and epithelial overgrowth owe their origin to persistent rudiments of the Wolffian body. The cysts may also arise by dilatation of the tubules or of the lymphatics.

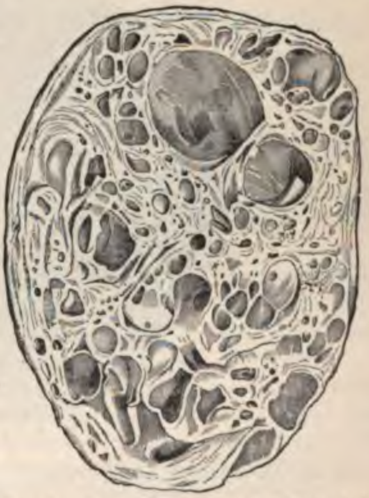

Fig. 185.—Cystic adenoma of the testis (Ziegler) (from a boy æt. four; natural size).

Simple cystic fibroma.—This form is chiefly composed of rounded, oval, or polyhedral cysts which may intercommunicate and are separated by a varying, usually small, amount of fibrous tissue in which islands of embryonic cartilage are sometimes seen. The cysts are lined by columnar epithelium which may be ciliated; the cells may be in several layers, and as the epithelium multiplies and desquamates the cysts may become filled with the cell masses which have a pearly appearance. The cysts which are not filled by epithelium contain serous straw-coloured or glairy chocolate-coloured fluid; the brown colour is due to altered blood. The tunics of the testicle are usually thickened, and the sac of the tunica vaginalis may be more or less obliterated by adhesions, or it may contain a little fluid.

Signs.—Cystic fibroma usually occurs in patients between thirty and forty years of age, but may be met with in the young or old.

The tumour is quite innocent. The growth is usually slow,
less, and progressive; the testicle retains its normal oval outlin
rarely attains a large size. The cord remains unaffected and
are no secondary deposits in the glands. The patient's
remains good. It sometimes happens, however, that the

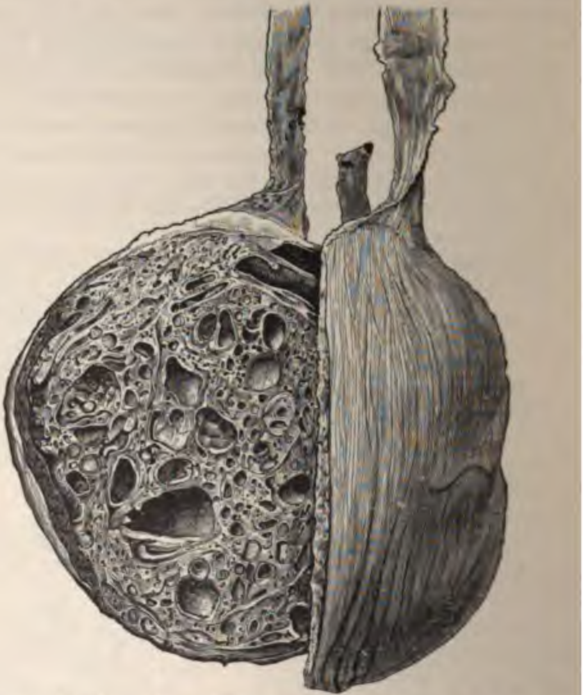

FIG. 186.—A testis much enlarged by cystic disease. The growth consists of a mass
most of which are minute, but some are a third of an inch in diameter. The greater
contained a clear, nearly colourless, slightly albuminous fluid. Some were found fil
opaque, soft, curdy matter. The stroma was rich in ill-developed connective-tissue
round and spindle cells being thickly scattered throughout it. Cartilage was also abu
met with (Jacobson).

fibroma develops malignant features and assumes the cl
characters of cystic sarcoma.

The diagnosis presents difficulties and must be made
simple or syphilitic chronic orchitis, from vaginal hæmatocele
from other tumours of the testicle (p. 631).

Cystic sarcoma.—The essential structure of this for growth is similar to that just described, but the fibrous tissue is more or less mixed with sarcomatous elements, and in many specimens myxomatous and unstriped muscular tissue, glandular structure, and embryonic cartilage are also found, so that a tumour of very mixed features, similar to that met with in the parotid gland, results. The cysts contain intracystic growths similar to those met with in cystic sarcoma of the breast. These tumours tend to invade the cord and reproduce themselves in the iliac glands.

Signs.—The growth of cystic sarcoma is comparatively rapid, and as the tumour increases in size it may become irregular on the surface. The cord is at first unaffected, but the growth soon invades its structures. If the iliac glands are involved there may be pain on pressure in the inguinal region, and perhaps some œdema of the leg. The general diagnosis is similar to that of malignant disease of the testicle (p. 636).

Treatment of cystic testicle.—Cystic disease of the testicle calls for immediate castration.

DERMOIDS OF THE TESTICLE AND SCROTUM

Dermoid tumours may originate in the body of the testicle or outside it in the scrotal tissues; in the latter case the testicle may be unaffected, but as the tumour grows it may implicate the tunics and perhaps the body.

Dermoids originating in the testicle may be due to fœtal inclusion, or according to some, to parthenogenesis. These tumours present the usual characters of dermoids met with elsewhere; they are sometimes spontaneously cured by suppuration.

Diagnosis.—The diagnosis of these growths is usually only arrived at by aseptic incision. Although congenital in origin the tumour may not make its appearance until the age of, or after puberty, and sometimes its growth appears to be connected with injury or inflammation.

The tumour grows slowly and painlessly unless inflammation and suppuration set in. The consistency varies, and may do so at different parts of the tumour.

Treatment.—Scrotal dermoids may be enucleated or laid open and sharp-spooned.

Dermoids growing in the body of the testicle or involving it by extension from the scrotum necessitate castration; but if they are small, incision and sharp-spooning may first be tried.

MALIGNANT TUMOURS—CARCINOMA AND SARCOMA

Malignant disease of the testicle usually occurs during the most active period of sexual life, viz. between twenty-five and forty-five years of age. Sarcoma is sometimes met with in quite young children. It may occur in connection with an undescended testicle, and the diagnosis of the condition may then be attended with considerable difficulty.

Soft **glandular cancer** is the most common variety, but pure **sarcoma** or **mixed sarcoma** is sometimes met with. The sarcomata originate in the intertubular connective tissue of the rete testis, but carcinoma primarily affects the tubules. In their general appearance, clinical history, and treatment the varieties of malignant disease are practically identical, the distinguishing features of each being determined by microscopic examination. These tumours rapidly invade the whole organ; they spread along the epididymis and cord, involve the skin and fungate on the surface, and affect the iliac and lumbar glands so early that secondary deposits in these parts are usually present when the case is first seen. As the disease advances the sac of the tunica vaginalis becomes more or less obliterated or may be partially distended with fluid which is often bloody. Malignant tumours are very vascular, and hæmorrhagic cysts may form in their interior; cysts due to degeneration may also be present. Some forms of cystic disease of the testicle are sarcomatous, and hence are properly classed with malignant tumours (see p. 633). The true testicle substance is gradually replaced by the growth and no trace of it may be present.

Signs.—Malignant disease of the testicle proceeds rapidly and affects the pelvic glands early. At first the testicle is symmetrical in outline and retains very much its normal shape, but as the tumour grows and invades the tunics and tissue of the dartos the outline may become irregular. In its early stages at least the disease is unaccompanied by pain, although there may be some sense of weight and dragging along the cord and in the loins; later on the pain may be neuralgic and severe.

The enlargement may be increased by fluid in the tunica vaginalis, but this is always small in amount and on account of its admixture with blood may not be translucent, even if there be sufficient for this test to be applied.

A malignant growth is usually soft and may convey a sense of fluctuation, but occasionally it is hard and dense; the mass feels heavy and drags on the cord, which is enlarged by its gradual invasion by the growth. It sometimes happens that the tumour suddenly increases in size, with considerable pain, owing to an effusion of blood into its substance.

When the growth invades the dartos the skin becomes adherent and is finally destroyed, the tumour then fungates on the surface and forms a foul, sloughy, and bleeding mass (*fungus hæmatodes*). When the skin is affected the inguinal glands may be the seat of secondary deposits. Enlargement of the iliac glands is to be suspected if the patient complains of pain on palpation of the iliac region, and especially if there is œdema of the leg from pressure on the iliac veins. Although the general health is at first unaffected the patient rapidly shows evidence of its impairment, and there may also be signs of secondary deposits in the lungs and viscera.

Diagnosis.—Simple or syphilitic inflammation of the testicle may be confounded with new growth, but in these conditions the history, the slow progress of the enlargement, and the immunity of the epididymis and cord and lymphatic glands are diagnostic features. The effect of the administration of iodides will also be of assistance.

Tubercular epididymitis can hardly be mistaken for tumour provided a careful examination be made.

The greatest difficulty may sometimes occur in differentiating between hæmatocele and new growth (see p. 631), and when such difficulty arises the diagnosis must be cleared up by an aseptic incision before castration is proceeded with.

Prognosis.—Malignant disease of the testicle is an extremely serious malady in view of the rapidity with which secondary manifestations appear in the iliac and lumbar glands, and the impossibility of completely removing the disease when this has occurred.

Treatment.—Immediate castration is necessary; care must be taken that the cord is divided well above the disease. If the tumour has already fungated there is no hope of saving the patient's life by the operation, but it may, nevertheless, be performed with the view of removing a foul, sloughy, and bleeding mass, and thereby materially diminishing the pain and suffering of his remaining days.

CASTRATION

The operation of castration is thus performed:—

The parts having been shaved and properly cleansed the surgeon, holding the scrotum in one hand, makes the diseased testicle project well under the skin, and entering the knife just below the external abdominal ring cuts downwards to the end of the scrotum. By a few touches of the knife the cord and testicle are quickly defined. These are then separated from the scrotal tissues by means of the fingers, and any bleeding vessels are secured. The cord is now secured well above the disease, and if this, as may be the case in malignant or tubercular disease, extends high up, the incision must be prolonged upwards, and the inguinal canal opened, so that the cord can be secured above the mischief. During this procedure care must be taken not to damage the deep epigastric artery. If the cord is quite small it may be encircled with one ligature, but if large it must be transfixed and tied with stout aseptic silk in two halves, or each vessel may be separately secured. The cord should be divided with scissors about half an inch beyond the ligature, and if the canal has been opened this should be closed with chromic gut or kangaroo tendon. If the disease necessitating castration has implicated the skin the involved portion should be removed with the testicle. When all vessels have been tied the skin wound must be carefully united with horse-hair, a small drain being placed at its lower end. In bringing the edges together care is needed to secure proper approximation owing to the great tendency of the scrotal skin to curl inwards. An antiseptic dressing is applied, and may remain untouched for a week, when the wound will be found practically healed.

The operation of castration is occasionally followed by cerebral symptoms and temporary mania. This is especially so when both testicles have been removed in elderly men (see p. 571).

DISEASES OF THE SPERMATIC CORD

VARICOCELE

A varicose condition of the veins of the pampiniform plexus is known as varicocele.

Causes.—Varicocele is usually met with in youths and young men, and affects the left side much more commonly than the right.

Varicoceles coming under the observation of surgeons are very common, but in addition many suffer from the complaint who never require treatment either because they are ignorant of its existence or because it causes no pain or inconvenience. Of the various causes given for the production of varicocele it seems very doubtful if many of them have any real causative effect. Thus the influence of the pressure exercised by the sigmoid flexure, the angle of junction of the left renal and left spermatic veins, sexual indulgence, and other causes have probably been much exaggerated. The length of the veins, their loose surroundings and varying states of distension are doubtless predisposing causes, but it is highly probable that the development of varicocele is due in the main to a congenital predisposition and a condition of the veins analogous to venous nævus.

Morbid anatomy.—The changes characteristic of varicocele are most marked low down near the epididymis, gradually becoming less so towards the external abdominal ring, and rarely involving the vessels higher than this point. The veins are thickened, dilated, and thrown into long sinuous folds; they also appear to be, and frequently are, more numerous than normal. This is partly owing to their distended state bringing into prominence veins which are normally quite small. The effect of the altered venous circulation on the testicle is practically *nil*, but in rare cases it is somewhat softer than natural, and may even undergo atrophy. Inflammation and thrombosis is very rare.

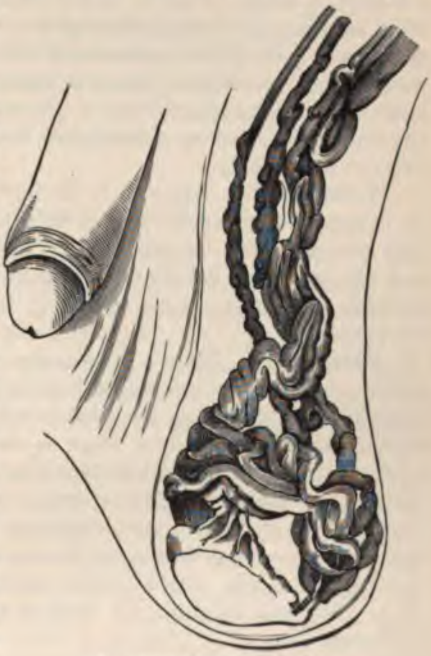

FIG. 187.—Varicocele (Follin).

As a consequence of injury a vein or veins may rupture, and profuse bleeding into the loose cellular tissue results (*scrotal hæmatocele*, p. 605).

Signs.—A varicocele forms a pendulous, compressible, wormlike mass in connection with the cord. There may be a distinct impulse on coughing. It is larger at the testicle than higher up, and ceases at the ring. The scrotum is lax and elongated, and the coiled veins can be plainly seen beneath the skin. When the patient lies down, especially if the scrotum be raised, the engorgement of the veins is relieved, and the swelling becomes much less prominent, but it at once returns when he stands, even although the finger be placed over the abdominal ring. The signs of varicocele are especially marked after violent exercise and in hot weather, since the engorgement of the veins is greater and the tissues of the scrotum are more relaxed. Pain is usually absent, but the patient, especially after exercise or long standing, often complains of a dragging sensation in the cord and round the loins. Sometimes there is well-marked neuralgia. Seminal emissions may be frequent, and exercise a depressing influence on the patient, who is occasionally the subject of sexual hypochondriasis and fits of depression amounting even to melancholia.

Treatment.—When it is decided not to effect a radical cure by operation the patient should be advised to wear a suspender, so that the veins may be supported. His bowels must be regulated, and he should be directed to lead a regular life and take a proper amount of exercise. Cold douching to the loins and scrotum will be beneficial.

Operation.—When a varicocele is large and is causing the patient inconvenience, when he has decided pain, frequent nocturnal emissions, or when his thoughts continually dwell upon the local condition, and especially if there is evidence of impaired nutrition of the testicle, a curative operation should be undertaken. Patients with varicocele are debarred from entry to the public services, because the condition may, especially in hot climates, unfit them for their duties, and, moreover, may be used as an excuse for "going sick" unnecessarily, therefore the radical cure must be undertaken on all who wish to enter the navy or army. The operation is thus performed:—

An incision about an inch and a half long is made in the scrotum just below the external ring. The cord is exposed, and the coverings being peeled off it, the vas is separated and the veins are isolated. The bundle of veins is then ligatured with silk or kangaroo tendon close to the external ring, and again close to the testis, the varicocele being drawn up into the wound for this purpose. The portion between the ligatures is then excised about half an inch beyond each ligature. The two stumps are next accurately stitched together with silk, kangaroo tendon, or chromic gut, so that the cord is thereby shortened and the testis is drawn up. The wound is dried and united with horse-hair, a small part being left open below to allow serum to escape.

The dressing may remain untouched for ten days (provided there is no rise of temperature), when the wound will be found healed, and the patient may be allowed up at the end of a fortnight, but should wear a suspender.

It is by no means unusual after this operation for the patient to complain of pain in the back, which may be very severe, but usually passes off in a couple of days.

Epididymitis occasionally occurs, especially if the vas has been roughly separated from the veins or the testicle has been manipulated. Under modern treatment cellulitis and phlebitis ought never to occur, but should this unfortunately result sloughing of the scrotum and pulmonary infarcts may be occasioned, and a fatal termination ensue.

ENCYSTED HYDROCELE OF THE CORD

Encysted hydrocele of the cord is nearly always due to the dilatation of a portion of the processus ad testem which has not been obliterated. A similar condition may occur in women in connection with the canal of Nuck (p. 646).

Encysted hydrocele may also arise by dilatation of the lymph spaces. The cysts which originate in connection with the organ of Giraldès are described with encysted hydrocele of the epididymis (see p. 628).

Signs.—The condition is usually met with in childhood or youth. There is an oval or rounded fluctuating tumour which is clearly defined, and smooth on the surface; it is in connection with the cord, as may be demonstrated by the fact that it can be moved with the cord but not independently of it, hence if the testis be free the tumour may be pushed up into the inguinal canal and so simulate hernia, but this becomes impossible as soon as the testis is held steady by one hand. If the cyst is lower down the freedom of the ring is easily ascertained. It is quite painless, and in the majority of cases is translucent, and lies close to the external ring.

Treatment.—Acupuncture may be practised with success in young children. In older patients the cyst should be removed by dissection, the opportunity being taken to suture the ring if it is enlarged. Cure may also be effected by aseptic incision and drainage.

DIFFUSE HYDROCELE OF THE CORD

From unknown causes serous fluid may be effused in considerable quantity beneath the connective-tissue sheath of the cord, and give rise to a cylindrical swelling along it, but distinct from the testicle and epididymis. The tumour is quite uniform, smooth, and painless, has no impulse like a hernia, and cannot be reduced into the abdomen. The condition is very rare. If absorption does not occur cure may be effected by aseptic incision and drainage.

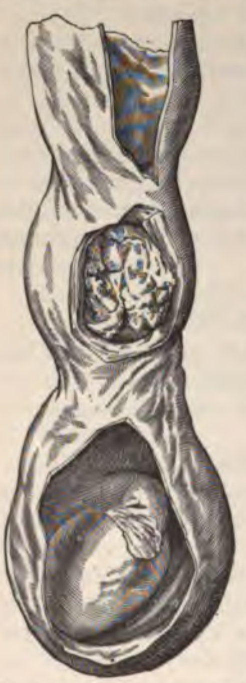

FIG. 188.—Encysted hæmatocele of the cord (Curling).

ENCYSTED HÆMATOCELE OF THE CORD

This condition, like the encysted hæmatocele of the testis and epididymis, is due to hæmorrhage into an encysted hydrocele. As a consequence of injury there is a sudden increase in the size of the swelling, and some pain is present. The tumour is very tense and opaque.

Treatment.—The treatment is that for hæmatocele of the tunica vaginalis (p. 631).

DIFFUSE HÆMATOCELE OF THE CORD

Diffuse hæmatocele of the cord is more common than the encysted variety, and results from injury. The onset is sudden, and the amount of hæmorrhage may be so great as to cause the patient to exhibit distinct signs of loss of blood. The cord cannot be isolated, and although the blood may extend up towards the abdomen, so that hernia is suspected, the mass cannot be reduced, and the signs of strangulation of a hernia are absent.

Treatment is conducted on the same lines as for hæmatocele of the tunica vaginalis. Aseptic incision should not be undertaken until all chance of absorption has passed.

TUMOURS OF THE CORD

Primary tumours of the spermatic cord are rare, but it becomes invaded by the extension of malignant growths from the testicle.

Primary tumours belong to the connective tissue group, but of these **lipoma** is the only one which need be specially mentioned.

These fatty growths originate from the subperitoneal fat to which they are connected by a narrow pedicle, and hence they clinically closely resemble an irreducible omental hernia. Similar tumours are sometimes found in the inguinal canals of women. The tumour is ovoid in shape, usually uniform in outline, and occupies the inguinal canal. It is irreducible, but like encysted hydrocele, for which it may be mistaken, can be pushed up with the cord. Lipomata occasionally become myxomatous and may develop sarcomatous properties. They can be readily removed, but in so doing care should be taken to make certain that the centre of the supposed tumour does not contain a hernial sac, for it sometimes happens that the subperitoneal fatty covering of a hernial sac is much increased in amount.

Diffuse lipoma of the cord is sometimes seen, and is likely to be mistaken for diffuse hydrocele or hæmatocele.

DISEASES OF THE VESICULÆ SEMINALES

VESICULITIS

Causes.—Acute or chronic vesiculitis is usually due to gonorrhœa, and occurs in connection with prostatic inflammation. It may also be met with in cases of stricture of the urethra or in prostatic disease other than that of gonorrhœal origin.

Signs.—The symptoms of vesiculitis are similar to those of prostatic inflammation, and are frequently attributed to it. Rectal examination will reveal the fact that the vesiculæ are enlarged and tender, and they can be felt extending upwards from the prostate like the two horns of a crescent. If the bladder is distended during the examination the condition of the vesiculæ will be more readily determined.

Painful and frequent erections are often complained of, and the patient may be troubled by bloody emissions which cause considerable pain. In the acute form suppuration may result, but rarely does so. Should it do so an abscess forms in front of the rectum, and extends upwards and towards the perineum. Owing to the proximity of the peritoneum, upward extension of the matter is by no means unattended by danger.

Chronic vesiculitis is a very tedious complaint, and is at the bottom of many cases of prolonged gleet, and although cure will usually result in time, the treatment is very tedious (p. 580). Chronic inflammation may occasion cystic dilatation of the vesicle, and this may be so marked that a definite tumour (not to be mistaken for enlargement of the prostate) forms between the bladde and rectum, and bulges into the perineum.

Treatment.—Treatment must be conducted on the same lines as for analogous conditions of the prostate. If abscess forms the pus must be evacuated by a timely incision through the perineum, and in the rare event of an appreciable cyst arising in chronic cases similar treatment is necessary.

TUBERCULAR VESICULITIS

The vesiculæ seminales are secondarily affected in cases of tubercle of the epididymis, prostate or bladder. Primary tubercular disease is very rare.

The vesiculæ become enlarged, indurated, bossy in outline, and tender. If the patient survives long enough the tubercular material softens and breaks down and a chronic abscess results, but this is rare, for the primary condition is usually fatal before it can take place. Rectal examination will show that the prostate is similarly diseased.

Treatment.—Tubercular vesiculitis rarely calls for special treatment in view of the condition of the patient and its secondary nature. If an abscess forms it must be opened through the perineum, and its cavity carefully sharp-spooned. Excision of the vesiculæ has been successfully practised, but its applicability must be extremely rare.

CHAPTER XXIX

SURGICAL DISEASES OF THE FEMALE GENITAL ORGANS

DISEASES OF THE VAGINA AND EXTERNAL ORGANS OF GENERATION

PRURITUS

CONSTANT itching and irritation about the vulva may be dependent upon causes which cannot be ascertained. It often occurs from the presence of pediculi, or as the result of an irritating vaginal discharge or eczema; morbid conditions of the urine, especially if it be ammoniacal or contains sugar, may also cause the affection. Stone in the bladder is an occasional cause. In children an irritable form of vulvitis may be excited by thread worms passing from the anus. Pruritus is usually met with in elderly women, and may be so severe that the patient cannot sleep at night and has to lead a life of seclusion during the day; constant scratching to allay the irritation may lead to considerable inflammation. The cause must be sought for and removed; failing the discovery of any local cause the parts should be anointed with cocaine, or benzoic acid with lanoline, and scrupulous cleanliness must be observed. Regulation of the diet, especially the avoidance of stimulating food and alcohol, should be prescribed.

HYPERTROPHY—ELEPHANTIASIS

Hypertrophy of the labia majora, nymphæ, and clitoris may be congenital and is frequently seen in Negresses. Acquired hypertrophy is usually dependent on long-continued irritation; the labia are sometimes considerably enlarged by syphilitic inflammation. The enlargement is caused by the overgrowth of fibrous tissue;

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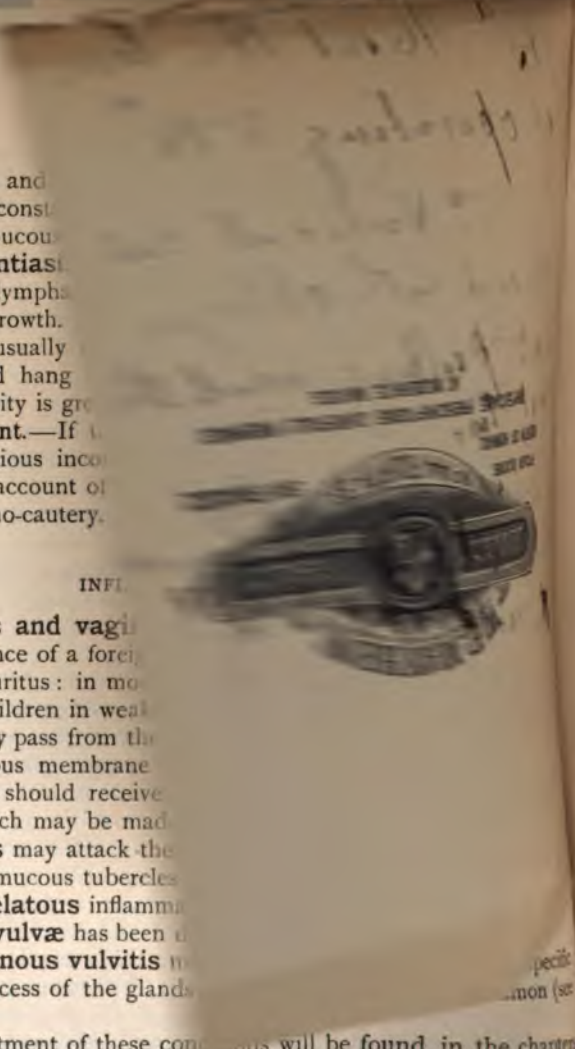

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Vulvitis and vagi
to the presence of a forei
produces pruritus: in mo

Little children in wea
which readily pass from th
of the mucous membrane
the surgeon should receive
violation which may be mad

Syphilis may attack the
the form of mucous tubercles

Erysipelatous inflamm

Noma vulvæ has been

Gangrenous vulvitis … pecific
fevers. Abscess of the glands … mon (see
p. 648).

The treatment of these con… will be found in the chapters specially dealing with them.

Fissures of the vaginal outlet sometimes cause intense pain during copulation, which may indeed be impossible. They may be readily cured by free dilatation as in the similar affection of the anus.

TUMOURS

Lipoma and hydrocele of the canal of Nuck are occasionally found in the labium major. The signs are very similar. The tumour gradually and painlessly increases in size; is freely

able, circumscribed, and elastic, and may sometimes be partially
ucible into the inguinal canal. Lipomata usually originate from
subperitoneal fat with which they are connected by a narrow
cle extending up through the ring. Hydrocele may be
slucent or distinctly fluctuating, and if the abdominal opening
e processus is not obliterated the fluid contents can be reduced
radual pressure, the tumour filling again when the patient
s up. The diagnosis must be made from inguinal hernia.
na or hydrocele should be treated by removal.

ibromata.—The soft fibroma or fibro-cellular tumour is occa-
lly met with growing from the labium major. It may attain a
arge size and become pedunculated, the pedicle in course of
being much elongated by traction. These tumours are very
ar; they should be removed by dividing the pedicle with the
y, the vessels (if the tumour be large) being first emptied by
essing the growth by the elastic bandage.

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ina, and should be removed when possible.

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ulated tumour like a fibroma; indeed the growths are usually

cous polypus of the vagina is very rare.

vus is occasionally met with in the labium. It is best
by excision.

illomata of the vulva are precisely similar to those met
the glans penis, and usually result from gonorrhœa. They
very large and form a mass like a cauliflower-head, com-
iding the normal configuration of the parts and extending
the anus. Ulceration is common and there is an extremely
harge; considerable pain and interference with locomotion
lt. The warts, which are strictly limited to the surface,
uld be removed with the cautery.

Squamous epithelial cancer usually begins near the meatus
arius or round the clitoris as a flattened indurated papule, which
dily ulcerates and spreads in all directions. The patient first
plains of intense smarting pain on micturition. Examination
als the presence of an indurated, intensely foul, and sloughing
r with raised hard edges. The inguinal glands are secondarily
cted, and as the disease advances it may spread to the bladder,
na, or rectum. Primary epithelioma of the vagina is very rare.
mited in extent the cancer may be removed by knife and cautery,
glands being also dissected away. In most cases the disease

the nymphæ and clitoris may project beyond the labia, and bei exposed to constant irritation become indurated and resemble sk more than mucous membrane; superficial ulceration is common.

Elephantiasis is common in Eastern countries. It is d pendent on lymphatic obstruction, which causes solid œdema a fibroid overgrowth. The labia chiefly suffer, but the nymphæ an clitoris are usually also affected. The parts may be enormo enlarged and hang down as pendulous masses between the leg The vascularity is great (see p. 99).

Treatment.—If the size of the parts or the presence of ulce tion is a serious inconvenience the redundant growth may be moved; on account of the free vascularity this is best accomplish by the thermo-cautery.

INFLAMMATORY AFFECTIONS

Vulvitis and vaginitis may be due to want of cleanlin to the presence of a foreign body, or to some local irritation such produces pruritus: in most cases it is gonorrhœal (p. 162, vol. i).

movable, circumscribed, and elastic, and may sometimes be partially reducible into the inguinal canal. Lipomata usually originate from the subperitoneal fat with which they are connected by a narrow pedicle extending up through the ring. Hydrocele may be translucent or distinctly fluctuating, and if the abdominal opening of the processus is not obliterated the fluid contents can be reduced by gradual pressure, the tumour filling again when the patient stands up. The diagnosis must be made from inguinal hernia. Lipoma or hydrocele should be treated by removal.

Fibromata.—The soft fibroma or fibro-cellular tumour is occasionally met with growing from the labium major. It may attain a very large size and become pedunculated, the pedicle in course of time being much elongated by traction. These tumours are very vascular; they should be removed by dividing the pedicle with the cautery, the vessels (if the tumour be large) being first emptied by compressing the growth by the elastic bandage.

Fibroma and sarcoma have been occasionally met with in the vagina, and should be removed when possible.

Myxoma is sometimes seen in the labium major and forms a pedunculated tumour like a fibroma; indeed the growths are usually mixed.

Mucous polypus of the vagina is very rare.

Nævus is occasionally met with in the labium. It is best treated by excision.

Papillomata of the vulva are precisely similar to those met with on the glans penis, and usually result from gonorrhœa. They may be very large and form a mass like a cauliflower-head, completely hiding the normal configuration of the parts and extending back to the anus. Ulceration is common and there is an extremely foul discharge; considerable pain and interference with locomotion may result. The warts, which are strictly limited to the surface, should be removed with the cautery.

Squamous epithelial cancer usually begins near the meatus urinarius or round the clitoris as a flattened indurated papule, which speedily ulcerates and spreads in all directions. The patient first complains of intense smarting pain on micturition. Examination reveals the presence of an indurated, intensely foul, and sloughing ulcer with raised hard edges. The inguinal glands are secondarily affected, and as the disease advances it may spread to the bladder, vagina, or rectum. Primary epithelioma of the vagina is very rare. If limited in extent the cancer may be removed by knife and cautery, the glands being also dissected away. In most cases the disease has so far advanced before the patient applies for relief that palliative measures only can be adopted. These consist in absolute cleanliness by free douching, the use of iodoform, and the application of local anodynes, such as cocaine.

CYSTS

Cysts may originate in the following ways :—(*a*) **The gland of Bartholin** lies at the entrance of the vagina, the duct opening on the inner side of the nympha close to the hymen. If the duct is obstructed a cyst containing clear glairy material and often attaining the size of a pigeon's egg may result. The wall of the cyst is thin and transparent; elasticity or distinct fluctuation is present. Suppuration may ensue. The cyst may be dissected out or laid open and the interior being swabbed out with chloride of zinc solution, grs. 40 ad ℥i.

(*b*) **Gärtner's duct.**—The lower end of this duct becomes incorporated with the wall of the vagina, and it is probable that some vaginal cysts owe their origin to its distension (see p. 661).

(*c*) **Mucous cysts** occasionally originate in the mucous glands of the vagina.

(*d*) **Serous cysts** are also sometimes found.

Vaginal cysts are very rare and are usually found on the anterior wall in the lower part of the canal. They are quite painless, localised, and elastic; they may suppurate. If causing inconvenience these cysts can be dissected out or laid open.

VESICO-VAGINAL AND RECTO-VAGINAL FISTULÆ

Fistulæ may form as the result of inflammation and sloughing consequent on labour, especially in prolonged cases, and after the use of instruments, or may be due to the spread of cancer.

Recto-vaginal fistulæ may arise in connection with syphilitic ulceration and stricture of the rectum. The size of these openings varies and the annoyance is proportional. No curative operations are possible in cancerous cases, but colotomy may afford considerable relief in recto-vaginal fistula.

When the fistula is the result of sloughing an operation may be undertaken when all inflammatory action has subsided for some time. The edges must be carefully pared and united by silkworm gut, which should not pass through the mucous coat of the bladder or rectum as the case may be. In vesico-vaginal cases the patient should be kept in the prone position for ten days and the bladder drained by catheter. In recto-vaginal fistula the after-treatment is the same as for ruptured perineum (p. 353, vol. ii.).

DISEASES OF THE UTERUS[1]

FIBRO-MYOMATA OF THE UTERUS

Fibro-myomata of the uterus are very common during the period of active sexual life; at the menopause they usually cease to grow, and undergo a certain degree of atrophy; but in rare cases growth continues, and sometimes advances with great rapidity. These tumours are frequently multiple, and may be situated beneath the peritoneum (*subserous*), in the thickness of the uterine wall

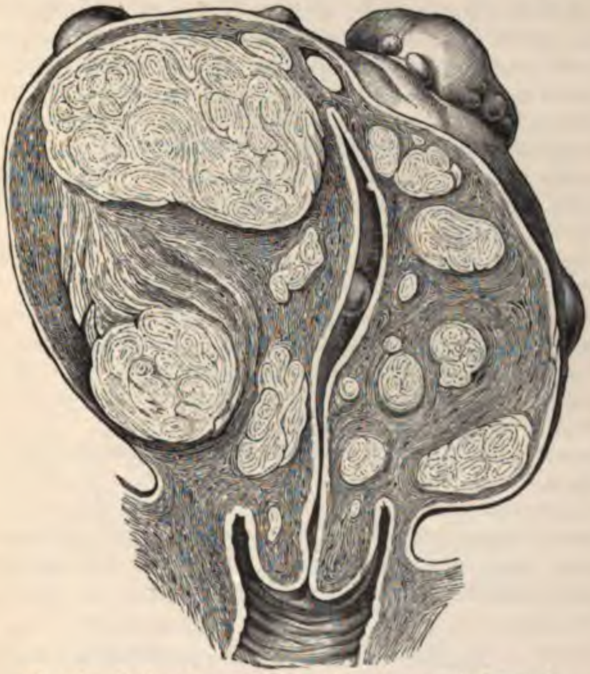

FIG. 189.—Section of a uterus with multiple myomata (Bland Sutton).

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[1] For a full account of these conditions the reader is referred to a work on Gynæcology, the strictly surgical aspects being alone dealt with here.

(*intramural*), or beneath the mucous membrane (*submucous*); in the first and last situations they may become pedunculated. Fibro-myomata are encapsuled, and possess large blood-vessels; they are usually dense in structure, but if growing rapidly may be much softer; they may become cystic, or may inflame, suppurate, or even become gangrenous as the result of infection. Impaction in the pelvis may occasion much trouble and prove a formidable danger should the patient become pregnant.

Symptoms.—Small tumours are frequently present without giving rise to any symptoms, but in some cases these are so severe that the patient is practically an invalid, and surgical interference is urgently called for. The gradual enlargement of the uterus, combined with profuse bleeding and pain, are the leading characteristics. The uterine cavity is much elongated, and the presence of the tumour can be made out by bi-manual or abdominal examination.

Surgical treatment of fibro-myomata.—When (in spite of treatment) fibroid tumours continue to cause profuse hæmorrhage, to rapidly increase in size and render the patient's life miserable, surgical interference becomes necessary. Oöphorectomy may be performed with the view of bringing about the menopause, and thereby arresting the hæmorrhage and the growth of the tumour. Subperitoneal tumours, especially if they are pedunculated, may be removed (*Myomectomy*); the pedicle is securely ligatured, and the peritoneum is united over it. Polypi projecting into the uterine cavity may be removed by the écraseur or wire loop after full dilatation of the cervical canal.

Enucleation of fibroid tumours after laparotomy, or dilatation of the cervix, according to the situation of the tumour, is an exceedingly dangerous operation, and one not to be recommended; death may result from hæmorrhage, peritonitis, or septic poisoning. In the worst cases of rapidly growing and cystic fibroids, partial or complete hysterectomy must be performed.

MALIGNANT DISEASE OF THE UTERUS

Cancer of the uterus is an extremely common disease, and usually occurs between the ages of forty and fifty. It may attack the cervix or the body.

Cancer of the cervix begins in the surface epithelium, or in that lining the glands; as the disease advances it tends to invade the vaginal walls, especially the anterior, and not infrequently fistulous communications with the bladder and rectum are established. The broad ligaments and lumbar glands are quickly implicated, and the ureters may be obstructed. The mass of cancer has a cauliflower appearance, and is often broken down and ulcerated; it gives rise to an intensely fœtid discharge, to profuse bleeding, and to pain which is sometimes severe. **Cancer of the body** of the uterus spreads over the mucous membrane and into the uterine wall; it causes considerable enlargement of the organ, and may excite pyosalpinx. The early symptoms are usually irregular uterine bleeding and pain. **Sarcoma** of the uterus is a rare disease, and usually affects the body.

Treatment.—Removal of the uterus is the only available method of treatment, but this can only be accomplished in the early stages before the disease has spread to surrounding parts.

The operation may be conducted by the vaginal or abdominal route, according to the circumstances of the case; but the latter is rarely advisable, and has a high mortality. When the growth is limited to the cervix, this portion may be amputated with the adjacent part of the body of the uterus (p. 653).

ABDOMINAL HYSTERECTOMY

In the following account of abdominal hysterectomy it will be presumed that the operation is undertaken for fibro-myoma, but the general steps of the operation are the same in all cases, the chief difference being in the treatment of the pedicle. In making the preliminary incision through the abdominal wall great care must be taken that the bladder, which is frequently drawn up by the tumour, is not damaged, and at the subsequent stages it and the ureters must be carefully protected from injury.

The abdominal incision must be long enough to afford every facility for the necessary manipulations, and when the mass has been fully exposed all adhesions must be carefully dealt with (p. 395). The tumour is now drawn out of the abdomen, and this step is much facilitated by the use of Greig-Smith's screws inserted into the mass at convenient situations. Each broad ligament is clamped close to the uterus, it is then ligatured some distance from the clamp, and divided between it and the ligature; the clamp is left in position to prevent bleeding from the uterine side, and to facilitate removal of the organ. When the uterus has been carefully isolated, it must be decided whether complete or partial removal is to be performed, and the subsequent steps are carried out accordingly.

Complete removal—Intra-peritoneal treatment of t

pedicle.—This is the preferable method and should always be employed unless special circumstances otherwise indicate. The broad ligaments must be tied low down so that the vessels are all secured, and the bladder must be carefully protected. The peritoneum is divided and is stripped downwards off the vagina, which (having been previously thoroughly cleansed) is then cut across, and its cut edge secured by forceps. The whole uterus is now removed. The vagina is closed with a continuous silk suture, and over this the peritoneum is similarly united. The peritoneal toilet is performed, and a piece of iodoform gauze is introduced into the vagina as a drain.

Partial removal—Extra-peritoneal treatment of the pedicle.—The lower part of the mass is encircled by Koberlé's serre-nœud, which is tightened sufficiently to arrest all circulation. The tumour is then cut away some distance beyond the wire, which should be gradually tightened up as this is in progress; the stump will be subsequently trimmed down. One or more pedicle pins are passed through the stump beyond the wire, and these resting against the abdominal wall draw the stump outside it; the vagina is necessarily dragged upon but yields in a few hours. The redundant portion of the stump is trimmed down with scissors, the peritoneal toilet is completed, and the abdominal wound is closed except at the lower end, where the pedicle is drawn into it; the parietal peritoneum may be united to the stump by a few points of suture. A strip of gauze must be packed round the pedicle, which should be dusted with iodoform or boracic acid, and the ordinary antiseptic dressing is applied. In about four days the wire may be released from the instrument holding it, but had better not be removed till the end of the first week. The stump of the pedicle gradually dries up and separates.

VAGINAL HYSTERECTOMY

For some days before the operation the vagina should be repeatedly cleansed (see p. 6, vol. ii.), the bowels should be regularly acted on, and must be quite empty at the time of the operation. The catheter is passed, and the patient placed in the lithotomy position. If the cancerous growth forms a large, foul, fungating mass in the vagina, this should be sharp-spooned and flushed away before the main operation is begun, and, if possible, this may with advantage be undertaken a week previously, so that the cleanliness of the vagina may be more certainly ensured.

The cervix is seized in a vulsellum, and forcibly drawn down and held in position by an assistant; if it is found impossible to draw the uterus down, the operation is contra-indicated. The mucous membrane round the cervix is divided with curved scissors, but the cutting must not be too deep or the bladder, ureter, and rectum will be endangered. The mucous membrane is now separated upwards with a blunt instrument, but this is only done in front and behind, and not at the sides; in effecting the separation, it is important to keep quite close to the uterine wall, or the bladder or rectum may be damaged, the former (which is in the greater danger) may be defined by the use of a sound. When the peritoneal reflections are reached the membrane is divided, and great care must now be taken that the peritoneal cavity is not fouled. The broad ligaments on each side are to be secured by clamp or ligature; the former is rapid and easy, but the latter is to be performed if it can readily be done. If the clamp is used, it should be removed on the third day, when all danger of bleeding will have passed away. The application of ligatures will be facilitated by rotating the uterus, so that its fundus projects into the vagina while the cervix looks upwards and backwards, but this plan has the great disadvantage of placing the diseased cervix within the peritoneal cavity; the broad ligament on each side is now transfixed, and is tied in two or three portions; if the ligatures can conveniently be placed outside the tube and ovary, these should be removed with the uterus, but they may be left.

When the uterus has been removed, the peritoneal pouch is cleaned with sponges; a drainage tube is introduced, and gauze is carefully packed round it. The tube should be left for three or four days, and gentle irrigation may be carried out through it, and should always be employed if there is any discharge.

AMPUTATION OF THE CERVIX

This operation is undertaken for limited cancer of the cervix. The operation is commenced as for vaginal hysterectomy, but when the mucous membrane has been reflected in front and behind care must be taken that the peritoneum is not wounded. The cellular plane on each side which is thus exposed, and in which the vessels run, is now clamped; this step is made easier if the uterus is drawn to the opposite side so that the tissues are put on the stretch. The tissues are next divided with scissors on the uterine side of the clamp. In place of the clamp the vessels on either side may be secured by a ligature, which is passed by means of a curved needle on a handle, and when possible this is the more preferable plan. The uterine sound is now passed to indicate the position of the cavity, and the cervical portion of the uterus (if necessary with part of the body) is removed by scissors which are made to cut upwards and obliquely inwards, so that the amputated portion is conical with the apex upwards. The area of operation is cleaned and dusted with iodoform or boracic acid, and the clamps, if retained, are wrapped round with gauze with which the vagina is lightly packed; they may be removed on the third day. The vagina should be douched each day and the gauze reapplied. In about a fortnight the patient will be well enough to get up.

CÆSAREAN SECTION

When it is impossible to effect delivery *per vias naturales* some operative procedure should be at once undertaken before the patient's strength is wasted by prolonged and fruitless labour.

Cæsarean section is usually performed, but Porro's operation may be necessary.

Operation.—The abdomen is opened in the usual way, but not too low down or the bladder may be wounded. Sponges are placed between the uterine and abdominal walls, and the uterus is pushed well up into the wound by the hands of an assistant placed behind it; by these means contamination of the peritoneal cavity by fluids is guarded against. If the situation of the placenta can be made out, the incision through the uterus should avoid it, but this is not of very great importance. A small cut is made with the knife in the upper part of the uterus, and is prolonged downwards to a sufficient extent by scissors. The hand is now introduced, the child is delivered by the head, and the cord ligatured and severed. The surgeon now waits a reasonable time in order to allow of separation of the placenta by the normal contractions of the uterus which are going on, and which may be further excited by ergot or the battery, but if separation does not occur he must effect it with his fingers, and must be careful to remove all the placenta and membranes.

The hand is now introduced and the patency of the os is ensured; a tube should be passed through this into the vagina for drainage. The uterine wound must now be closed by Greig-Smith's method—the peritoneum is separated for a short distance from the wall along each side of the cut, so that it tends to turn over the cut muscular tissue (which contracts), and thus the opposed peritoneal surfaces are brought into intimate contact. Deep sutures are passed through nearly the entire thickness of the wall, but must not enter the uterine cavity, and superficial sutures are then introduced; finally all are tied. The pouch of Douglas is sponged out and a drainage tube is placed in it and brought out at the lower end of the abdominal wound. If Cæsarean section is necessitated by contracted pelvis, which effectually precludes the possibility of natural delivery, the Fallopian tubes may be ligatured so that conception in the future is impossible.

As a rule there is no alarming bleeding, and it soon ceases with pressure and uterine contraction, but in the absence of the latter it may be very severe and require the removal of the uterus (Porro-Cæsarean operation). The dangers of Cæsarean section and other operations of this nature are shock, hæmorrhage, and subsequent peritonitis. The after-treatment consists in rigid asepsis, and that customary after abdominal operations.

THE PORRO-CÆSAREAN OPERATION

Porro's operation consists in removal of the uterus subsequent to delivery by Cæsarean section. It is necessitated by hæmorrhage and failure of uterine contraction after the latter operation, by the presence of a uterine myoma and by rupture of the uterus. In cases of cancer of the uterus it is sometimes advisable to remove the whole organ with the contained fœtus.

Operation.—When the child has been extracted by Cæsarean section no attempt need be made to separate the placenta. If the cut surface of the uterus is bleeding the edges should be clamped; the uterus is then withdrawn from the abdomen, flat sponges being used to protect the intestines. The neck of the uterus is encircled by Koberlé's serre-nœud, the uterus is then cut away and the pedicle treated by the extra-abdominal method as described at p. 652.

DISEASES OF THE FALLOPIAN TUBES

SALPINGITIS—HYDROSALPINX—PYOSALPINX

Acute septic salpingitis may occur in association with septic endometritis of puerperal or gonorrhœal origin and in cases of uterine cancer. Tubercular salpingitis is nearly always secondary to invasion from the uterus. When the tube is inflamed the abdominal end becomes obliterated by adhesions, a result which may also be due to perimetritis; the closed end is rounded in outline and the fimbriæ are inverted and hence not seen. In septic cases suppuration quickly ensues (*Pyosalpinx*). Sometimes the disease is of a catarrhal and chronic nature, or closure of the fimbriated end is the primary condition, and in these cases the tube becomes filled with fluid which may be clear, turbid, or blood-stained (*Hydrosalpinx*).

As the accumulation of fluid increases the tube becomes much distended; it is coiled on itself and resembles a bent retort, the outer end being the larger part. In septic cases perforation of the tube may occur and general peritonitis quickly prove fatal, but if the tube has become adherent to the gut rupture into it may prevent such an event; rupture into the vagina may also occur.

Symptoms.—The diagnosis of acute septic salpingitis is very difficult; it is practically identical in its symptoms with acute pelvic cellulitis and peritonitis.

In chronic cases of hydro- or pyo-salpinx the patient complains of pain which is often constant and severe, and there may be menorrhagia. Examination will reveal the presence of the enlargement, the outline of which is, however, often blurred by surrounding inflammatory effusion and adhesions. The pain, fixity, and relatively small size of the tumour will serve to distinguish it from an ovarian cyst.

Treatment.—In non-suppurative cases causing but little inconvenience, operative interference is not necessarily demanded, but in all others, with the exception of secondary tubercular mischief, removal of the appendages must be performed.

The difficulties and dangers of the operation may be very great in consequence of the adhesions and surrounding inflammation, and sometimes its completion is found to be impracticable; if this be so, incision and drainage must be resorted to.

TUBAL PREGNANCY

Under normal conditions the fertilised ovum occupies the uterine cavity, but from quite unknown causes gestation may occur in some part of the Fallopian tube, and tubal pregnancy results. The ovum may be situated in any part of the tube; when it lies in that portion which traverses the uterine wall the pregnancy is spoken of as tubo-uterine; the precise situation of the fœtus influences, to some extent, the events which may subsequently occur.

The pregnancy is frequently converted into a mole by hæmorrhage within the membranes. As gestation proceeds the tube becomes gradually expanded and thinned. The fimbriated end usually becomes closed, although it does not necessarily do so; indeed it may remain preternaturally open. Closure of the tube usually occurs when the gestation occupies its outer third, but becomes less frequent the nearer the gestation is to the uterus. When occlusion takes place it is usually completed during the second month.

If the abdominal ostium remains open the gestation may be partly or completely discharged through it into the abdominal cavity (*tubal abortion*); the former is the more dangerous condition, for as the mole is retained within the tube, repeated hæmorrhages from it add to the gravity of the case.

Rupture of the sac of a tubal gestation usually occurs before the end of the third month, and its occurrence is often directly traceable to injury which may however be very slight. Rupture may take place into the peritoneal cavity or between the layers of the broad ligament (*extra-peritoneal rupture*); the former is the more usual and also the more dangerous, since in the extra-peritoneal form the hæmorrhage is confined within the broad ligament, and hence is less profuse, but at any time the peritoneal investment may yield and the case be converted into one of intra-peritoneal rupture (*secondary rupture*). Rupture is a most dangerous accident, and in the absence of surgical interference is usually rapidly fatal. Sometimes, however, the fœtus continues to develop and the pregnancy goes on to term when labour pains set in and operation becomes necessary, or after a time the pains cease and the child dies; if the fœtus die, it may dry up, and become infiltrated with lime salts (*Lithopædion*). In the last case no harm may result, or suppuration may ensue and the abscess burst in the vagina, bladder, rectum, peritoneal cavity, or through the abdominal wall, and continue to discharge fragments of the disintegrated fœtus. It is held by many that pelvic hæmatocele is usually due to tubal abortion or rupture.

Rupture of a tubo-uterine gestation is often delayed beyond the third month owing to the more resistant nature of the surroundings of the sac. When it does occur the rupture may be intraperitoneal or intrauterine. In the latter case the fœtus is extruded *per vias naturales.*

Diagnosis.—The diagnosis before abortion or rupture is extremely difficult. The patient may or may not know that she is pregnant, and the secondary evidences of this condition may be absent or well-marked. When rupture or abortion occu patient is seized with sudden pain, and may be distinctly consc of something having given way. There is marked collapse a signs of severe internal hæmorrhage; blood not infrequently esc by the uterus. The signs closely simulate those of rupture of abdominal viscus, of a pyosalpinx, or of the vermiform appen Vaginal examination may reveal the presence of a tumour to o side of the uterus, which may itself be found slightly enlarged.

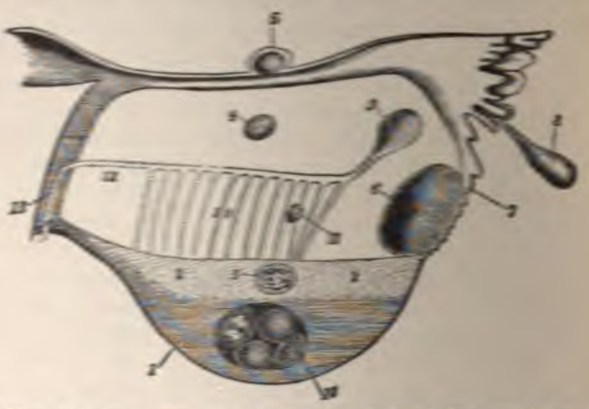

FIG. 290.—Diagram of the structures in and adjacent to the broad ligament (Alban Doran). framework of the parenchyma of the ovary, seat of 1a simple or glandular multilocular cy 2, tissue of hilum, with 3, papillomatous cyst; 4, broad ligament cyst, independent of pa varium and Fallopian tube; 5, a similar cyst in broad ligament above the tube bu connected with it; 6, a similar cyst developed close to 7, ovarian fimbria of tube; hydatid of Morgagni; 9, cyst developed from horizontal tube of parovarium. Cysts 4, 5, 8, and 9 are always lined internally with a simple layer of endothelium; 10, the parova the dotted lines represent the inner portion, always more or less obsolete in the adult; cyst developed from a vertical tube; cysts that have this origin, or that spring from obsolete portion, have a lining of cubical or ciliated epithelium, and tend to develop pap matous growths, as do cysts in 2, tissue of the hilum; 12, the duct of Gärtner, often pers in the adult as a fibrous cord; 13, track of that duct in the uterine wall; unobliterated por are, according to Coblenz, the origin of papillomatous cysts in the uterus.

Treatment.—As soon as tubal pregnancy is diagnosed laparotomy must be performed. In the early stages the operation anticipates rupture or abortion, but if these should have occurred it is urgently demanded in order to save the patient's life by the arres of the profuse bleeding. If the pregnancy has advanced so far that it cannot all be removed with the uterine appendages, the sac must be laid open, the fœtus and placenta cleared away, and the sac wall united to the abdominal wound and drained. If the placenta cannot be safely removed it must be left.

If a dead fœtus excites suppuration and an abscess bursts into ıe vagina or elsewhere, it must be freely opened up and the ontents evacuated.

DISEASES OF THE OVARIES

CYSTS OF THE OVARY AND PAROVARIUM

Origin and classification. — The ovary consists of the ɔöphoron and paroöphoron. The former contains the ova in various stages of development, but the latter consists of fibrous tissue and blood-vessels only. Connected with the paroöphoron, and lying between the ovary and Fallopian tube (mesosalpinx), is the parovarium. This structure is the remains of the Wolffian body, and consists of eight or nine epithelial-lined blind tubules radiating from the paroöphoron, and joining with a larger tubule which runs at right angles to them. This horizontal tube is the homologue of the vas deferens, and is known as Gärtner's duct. At the outer end of this duct there are three or four short blind tubules (Kobelt's tubes) which have free extremities (Fig. 190).

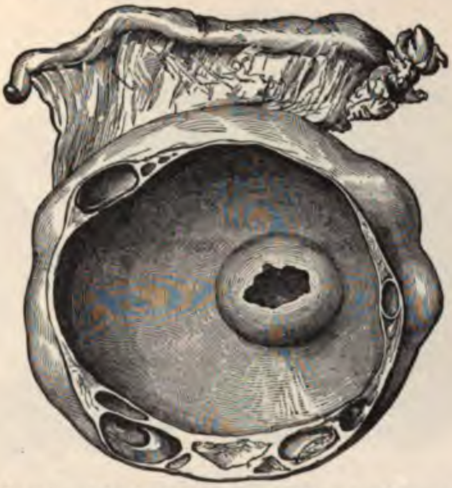

FIG. 191.—A small multilocular ovarian cyst, slightly reduced from natural size (Alban Doran, from No. 275, Museum Royal College of Surgeons).

A cyst may arise in connection with any of the above-mentioned structures, but each has certain peculiarities according to its mode of origin. Thus we have :—

1. **Cysts of the oöphoron** . . .
    - Simple cysts.
    - Cystic adenomata.
    - Dermoids.
2. **Cysts of the paroöphoron.**
3. **Cysts of the parovarium** .
    - Cysts of the vertical tubes.
    - Cysts of Gärtner's duct.
    - Cysts of Kobelt's tubes.
4. **Tubo-ovarian cysts.**

The general structure of cysts.—Simple cysts (oöphoron) arise by dilatation of the ovarian follicles, and may be uni- or multilocular (Fig. 191, p. 659). They may be very small or attain an enormous size. Quite small cysts are lined by epithelium, but this soon atrophies from pressure. As the cyst grows it gradually replaces the ovary. The Fallopian tube lies above the tumour.

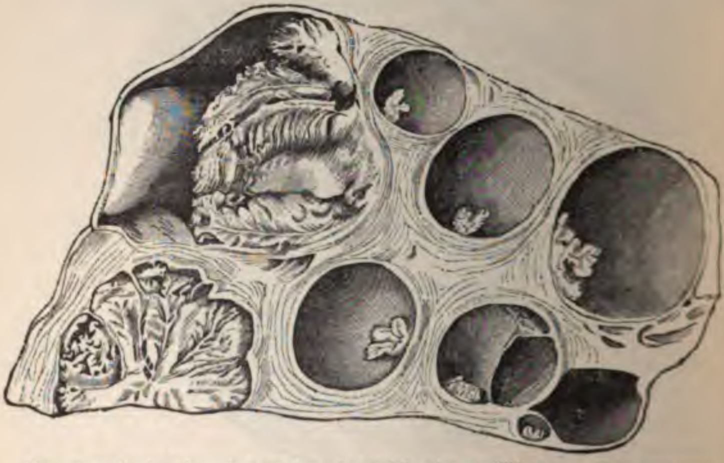

FIG. 192.—Section through a portion of a multilocular papilliferous ovarian cystoma; natural size (Ziegler).

Cystic-adenomata (oöphoron) are composed of innumerable loculi, so that when cut across such a tumour has the appearance of a sponge or honeycomb (Fig. 192). The loculi are lined by columnar epithelium.

Dermoids (oöphoron).—The general characters of dermoids have been described on p. 258, vol. i. They do not attain so large a size as the other forms, and often have very dense and hard walls, and in consequence of their weight are more likely to rotate on the pedicle (see Fig. 195, p. 664).

Cysts of the paroöphoron are nearly always unilocular, and grow between the layers of the broad ligament. The interior is usually covered with papillomatous masses, which may completely fill the cavity, and should the cyst burst, will produce widespread papillomatous infection of the pelvis and general surface of the peritoneum with an effusion of fluid into the abdominal cavity.

These secondary papillomata often disappear when the primary tumour has been removed.

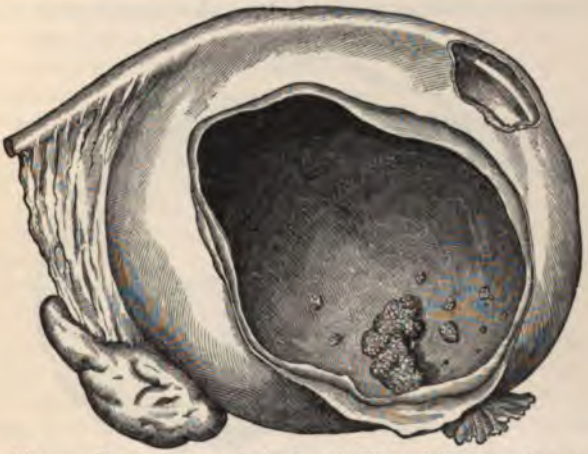

FIG. 193.—A large papillomatous cyst springing from the hilum of the ovary, the greater part of which organ is not involved in the morbid growth. The cyst has forced its way between the layers of the broad ligament as far as the Fallopian tube; this condition has been made more clear by removal of a part of the ligament over the tube and another part over the cyst; the corresponding portion of the wall of the cyst has also been taken away to expose its cavity (Alban Doran).

Parovarian cysts arising in connection with the vertical tubes or Gärtner's duct burrow between the layers of the broad ligament. Cysts arising in Gärtner's duct project towards the vagina through which they have sometimes been evacuated. The Fallopian tube is often much stretched, and the ovary lies on one side of the cyst, which is usually unilocular (Fig. 194, p. 662). The walls are thick or thin, and destitute of or lined by columnar epithelium, according to the age and size of the cyst. The fluid is usually limpid and of low specific gravity. Parovarian cysts rarely attain a large size, nor do they contract adhesions or suppurate. They are never met with before puberty.

Cysts of Kobelt's tubes are quite small and pedunculated. They are of no clinical importance.

Tubo-ovarian cysts — Ovarian hydrocele.—Cysts connected with the ovary sometimes also communicate with a distended Fallopian tube, giving rise to a unilocular tumour shaped like a retort. It is possible that some of these cysts may be due to inflammatory fusion of the tube with an ovarian cyst, but according to Bland-Sutton most of them arise in the following way :—

The ovary is sometimes invested by a peritoneal sac analogous to the tunica vaginalis testis, and with this sac the end of the Fallopian tube communicates. Under such circumstances distension with fluid will produce a cyst of the nature described. This condition is known as ovarian hydrocele. Suppuration may occur, and in very rare cases the fluid may periodically find its way along the tube to the uterus, and thus escape externally. Ovarian hydrocele is distinguished from hydrosalpinx by the freedom of the ovary in the latter condition.

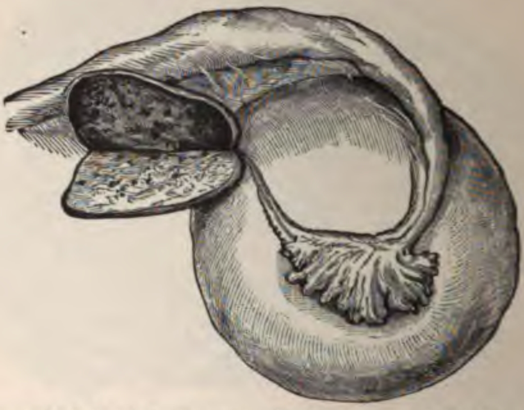

FIG. 194. A simple broad ligament cyst. The bisected ovary is free from the cyst over which the Fallopian tube is coiled (Alban Doran).

Complications arising in connection with ovarian cysts—Rupture of the cyst may arise from mere tension, but is usually due to injury. The possibility of rupturing a cyst during examination of the abdomen must be borne in mind. The effects of rupture depend upon circumstances. A loculus may rupture into the parent cavity, and frequently does so. If the outer wall ruptures the fluid escapes into the general peritoneal cavity, but in rare cases rupture into a viscus occurs. If a cyst ruptures it by no means follows that all the fluid will escape, for the opening may become blocked by secondary cysts or solid contents. If an appreciable quantity escapes there will be a proportionate diminution in the size of the tumour, accompanied by dulness in the flanks, and the signs of free fluid in the peritoneal cavity. The presence of the fluid in the peritoneal cavity usually does no harm provided the cyst be not inflamed (see Paroöphoronic Cysts, p. 661).

Inflammation and suppuration.—A mild degree of inflammation leading to the formation of adhesions between the cyst wall and its surroundings is not uncommon. The adhesions may be very intimate and almost universal, so that their separation is tedious and hazardous, or may be impossible.

Adhesions may be very vascular, and supply enough blood to the tumour to keep it alive after it has separated from its pedicle (see below). Severe inflammation leading to suppuration of the cyst is more rare, but is also much more dangerous. It more usually occurs in dermoids.

Inflammation and suppuration may be excited by infection through the Fallopian tube or vermiform appendix, and not infrequently followed the old operation of tapping.

If suppuration occurs the abdomen is exceedingly tender to the touch, and the patient complains of great pain. She is very ill, lies with the legs drawn up, and soon falls into an exhausted typhoidal condition with a high temperature. Unless quickly relieved by operation she will sink exhausted, but occasionally spontaneous relief is afforded by the cyst rupturing externally, or into the vagina, bladder, or a portion of gut, in which cases she will discharge large quantities of pus, and sooner or later probably die from exhaustion and hectic unless surgery saves her.

Parovarian cysts are very rarely found adherent, nor do they suppurate.

Twisting of the pedicle.—The pedicle, especially if it be long, and the tumour freely movable, may become partially or completely twisted, and sometimes multiple twists are seen.

This accident is especially likely to occur in association with pregnancy, and in the case of small and heavy tumours, such as dermoids.

The effects of torsion of the pedicle vary with the tightness of the twist and the rapidity or otherwise of its occurrence. If it is acute and tight the cyst may necrose; if more slowly produced the thin-walled veins are compressed, while the arteries still receive blood, and consequently there is extreme congestion with perhaps severe venous bleeding into the cyst, which on exposure will have somewhat the appearance of a tightly strangulated hernia. In the least severe cases the impediment to the blood supply merely causes an arrest of growth, or the tumour may gradually separate from the pedicle, but remain alive owing to its deriving a sufficient blood supply through adhesions which it has contracted (*transplantation*, Fig. 195).

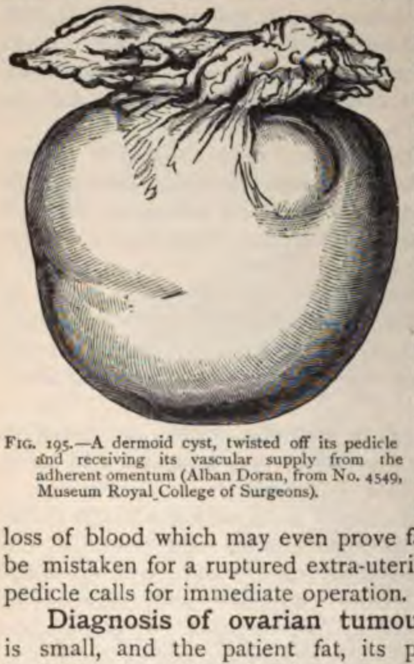
FIG. 195.—A dermoid cyst, twisted off its pedicle and receiving its vascular supply from the adherent omentum (Alban Doran, from No. 4549, Museum Royal College of Surgeons).

Acute torsion gives rise to intense pain with vomiting and collapse, such as is seen in cases of intestinal obstruction, but the vomiting does not become fæcal. If there is much bleeding the patient may exhibit all the signs of loss of blood which may even prove fatal. Such cases may readily be mistaken for a ruptured extra-uterine gestation. Torsion of the pedicle calls for immediate operation.

Diagnosis of ovarian tumours.—If an ovarian tumour is small, and the patient fat, its presence may easily be overlooked, and, on the other hand, ovarian tumour may be diagnosed when none is present. In cases of doubt it is advisable to examine the patient under an anæsthetic. In a well-marked case the abdomen will be found distended; sometimes the enlargement is uniform, at others the tumour occupies one or other side of the middle line, or at least is in such a position that the contour of the abdomen as the patient lies on her back is markedly irregular The abdomen is protuberant in front, and frequently flattened in the flanks. The protuberant portion is dull on percussion, but there is resonance all round it. If the tumour is cystic there may be very evident fluctuation within the dull area, or it may be limited to certain portions only, as in the case of a multilocular cyst. It is to be noted that the area of dulness and fluctuation does not shift its position with that of the patient as would be the case in free fluid within the peritoneal cavity, unless the tumour be small and freely movable. On palpation the rounded outline of the tumour may be very evident, especially in thin women. Sometimes it is bossy owing to the projection of loculi. The tumour may be distinctly traceable into the pelvis, and the patient may state that she noticed that the swelling gradually grew from below upwards towards the umbilicus. Solid tumours and some dermoids feel very dense and hard, and may be freely moved about if the pedicle is long, and the tumour free from firm adhesions to the parietes. Vaginal examination may reveal the presence of the tumour in the pelvis, and bi-manual examination will show that the uterus is drawn up towards the abdomen, and perhaps pushed over to the opposite, or dragged towards the same side. The uterus will usually be found to be separate from the tumour. The bladder may be similarly displaced, and from pressure on it and on the rectum the patient may complain of frequent micturition, constipation, and difficult defæcation.

Ovarian tumours have been mistaken for almost every conceivable abdominal swelling. When a pelvic abdominal tumour is found it is necessary to determine that it is not the pregnant uterus, and in coming to a conclusion on this point the surgeon must not pay too much attention to the asseverations of the patient. It must not be forgotten that an ovarian cyst may complicate pregnancy. A sound should never be passed until the question of pregnancy is definitely decided in the negative. Tumours of the omentum or retro-peritoneal tissue, of the uterus, kidney, or other abdominal organs may usually be differentiated by a careful analysis of the symptoms and physical examination. Pelvic hydatids may cause considerable difficulty. Phantom tumour is easily differentiated by administering an anæsthetic.

Ascites, when encysted, as in cases of tubercle, has misled many able clinical observers. A distended bladder is readily diagnosed by the passage of a catheter.

SOLID TUMOURS OF THE OVARY

Fibromata, fibro-myomata, sarcomata, and primary glandular **carcinoma** are met with in the ovary, but all are rare.

Fibromata, when they attain a large size, are often cystic. In general appearance they are like subserous fibro-myomata of the uterus. They have a long or short pedicle, which may become twisted. Sarcoma of the ovary may occur at any age, and has been met with in new-born children.

TREATMENT OF OVARIAN TUMOURS—OVARIOTOMY

Removal by ovariotomy should be performed as soon as the nature of the case is ascertained, and if there is evidence of suppuration, torsion of the pedicle, or rupture of the cyst the operation should be undertaken immediately.

The general steps of the operation are described at p. 394.

The pedicle must be secured in two portions; it is transfixed and the two ligatures are interlaced and then tied one round each half, and subsequently the ends of one ligature are passed round the whole pedicle and again tied to give greater security. If the pedicle is very broad three ligatures may be necessary. The tumour should be removed about half an inch beyond the ligature, which is cut short and the pedicle allowed to drop back into the pelvis. If the tumour is almost universally adherent it may be impossible to remove it, and incision and drainage must be resorted to, the cyst being stitched to the abdominal wall.

It sometimes happens that a cyst becomes impacted in the pelvis, and if the woman be pregnant may cause serious trouble, especially at the time of labour; if it is found impossible to dislodge the cyst it should be punctured and emptied, and may then yield in its collapsed state.

Parovarian tumours may be readily enucleated if the investing peritoneal coat is first divided and then separated from the cyst; but difficulty may arise if the tumour is firmly fixed at the bottom of the pelvis, which may necessitate the adoption of incision and drainage.

OÖPHORECTOMY

This operation consists in the removal of the ovaries and tubes which may or may not be the seat of inflammatory mischief.

Oöphorectomy has been practised for a variety of conditions. It is necessary in all cases of tubal disease giving rise to marked symptoms, and is occasionally performed in inflammation or displacement of the ovary. Oöphorectomy may be employed in cases of uterine fibromata with the view of anticipating the menopause; it is also of benefit in osteomalacia, and quite recently has been performed, with at least temporary benefit, in cases of inoperable cancer of the breast (see p. 688).

The operation is conducted on the same lines as ovariotomy; if the parts be not diseased it is very simple, but if the tubes are distended with pus or bound down by adhesions it may be most difficult to separate them. In such a case great care should be taken that the tube be not ruptured.

CHAPTER XXX

DISEASES OF THE BREAST

Anatomy.—The breast covers the thorax from the edge of the sternum to the margin of the axillary fold, and from the third to the seventh rib. These limits, however, apply merely to the evident prominence which the breast forms, and by no means bound its true extent, a knowledge of which is so important when removal is contemplated in cases of cancer. The breast is extensively spread out on the chest, and extends beyond its apparent margin upwards towards the clavicle, downwards towards the abdomen, and outwards towards the axilla, in which situations there are numerous lobules of breast tissue, and unless these be completely removed the cancerous growth is very likely to continue growing in them. Deep lobules may also be adherent to the pectoral fascia in which there is a rich lymphatic plexus which carries some of the lymph from the deeper parts of the breast to the axillary glands. Beneath the gland is a considerable amount of connective tissue—the pectoral fascia and the pectoralis major muscle; superficially it is separated from the skin by a layer of fat.

The breast is a racemose gland. The main ducts, about twenty in number, open at the nipple; in the substance of the breast the ducts branch repeatedly, the ultimate ramifications dilating into the acini of the organ. These acini and their ducts are united together to form lobules which are separated from one another by fat and connective tissue. Outlying lobules of breast substance are common and may extend a considerable distance above, below, or towards the apparent limits of the gland—a fact of importance in amputating for malignant disease. The ducts and acini are lined with short columnar or cubical epithelium. The nodular elevations seen in the areola of the nipple are the openings of small branched glands. The lymphatics from the breast pass to the glands along the subscapular artery and anterior fold of the axilla, and thence to the supraclavicular set. The lymphatic paths communicate with those found in the pectoral fascia, and hence the importance of removing this in amputation for cancer. The vessels are supplied by the long thoracic and external mammary branches of the axillary, the internal mammary, and intercostals. The male breast is like an imperfectly developed female organ, and although liable to the same pathological conditions, is very rarely affected by them.

DEVELOPMENTAL ANOMALIES

Supernumerary breasts are occasionally met with. The additional organ is usually placed between the true breasts or just under the anterior fold of the axilla; more rarely it is situated below one of the breasts, or in some remote position. Additional breasts are always small but may possess a perfect nipple and be functionally active; they are liable to all the pathological conditions affecting the normal gland. Sometimes there is merely a nipple-like projection on the skin, or an outlying lobule of the breast, whose presence is only ascertained when the organ becomes functionally active.

Absence of the breasts has been recorded, but is very rare. Occasionally the breasts of women retain their childish characters after puberty and throughout life.

FUNCTIONAL ANOMALIES

Agalactia.—It sometimes happens that the secretion of milk does not occur with parturition. Such a condition is dependent upon general ill-health, and is often due to want of proper nourishment and fresh air during pregnancy. If the patient is seized with any acute disease during the puerperal period, the secretion of milk may be completely and permanently arrested.

Galactorrhœa or excessive secretion of milk, which is usually of poor quality, is dependent on unknown causes. The quantity may be very great, causing not only serious inconvenience, but deterioration of the health. The excess of secretion may be drawn off with the breast-pump, and if the breast is very turgid and tender, glycerine and belladonna and hot fomentations should be applied. The bowels should be opened and kept acting by saline purges. Iodide of potassium is very useful in checking the secretion. The general health should be improved by good food, tonics, and fresh sea-air.

Abnormal secretion of milk may occur in the breasts of new-born children, young women, and even men. It is probable that, in the case of young women, the breast may be excited to secrete by frequently putting infants to the nipple in the hope of keeping them quiet. At puberty, pain and turgescence of the breast is common and sometimes a little milk is present.

Very little trouble results from this condition, but breast-abscess may occur. The treatment for galactorrhœa should be adopted when the severity of the case demands active measures.

MASTODYNIA

In the great majority of cases, neuralgia of the breast is an indication of the presence of some pathological condition and is very frequently associated with chronic mastitis. Apart from such causes mastodynia is rare, and is usually met with in young, so-called hysterical women, in whom amenorrhœa or some uterine trouble co-exists. Anæmia is often at the bottom of the mischief.

The pain is usually periodic and liable to be worse at the menstrual period and after manipulation of the breast. It is sometimes agonising and may be referred to a definite nerve, usually the intercosto-humeral, in which case it shoots down the inner side of the arm to the elbow. There is associated cutaneous hyperæsthesia and general tenderness.

Treatment.—The patient's general health must be improved and anæmia should receive special attention. The astringent preparations of iron, the syrup of the hypophosphites, cod-liver oil, and quinine are specially serviceable, combined with good nutritious food, plenty of fresh air and exercise, and regulation of the *primæ viæ*. Local anodynes may be serviceable for a time, but do not do any permanent good; the breast should be covered with a belladonna or opium plaster to prevent the patient fidgeting with it. During a paroxysm of pain a hypodermic injection of morphia may be necessary, but care should be taken in the use of the drug.

In one very severe case under my care, after exhausting all remedies at my command, I divided the intercosto-humeral nerve in the axilla (the pain being definitely referred to its course) with complete and permanent success.

ATROPHY OF THE BREAST

Atrophy of the breast is a constant change in advanced life and usually begins at a varying period after the climacteric, but may do so earlier. In some cases the normal process of involution after lactation may be excessive, and result in atrophy. Atrophied breasts by no means necessarily look small; they are indeed frequently much enlarged after the cessation of menstruation, the maintenance or increase of size being dependent upon fat, and the mammary substance itself being very small in amount (*false hypertrophy*).

The ducts are not involved in the atrophic process. The acini lose their epithelial covering, gradually shrink and become obliterated; some of them may escape and become distended with a clear fluid giving rise to cysts (*involution cysts*). Occasionally very many of these are present, so that the breast, unless there be much overlying fat, feels not unlike a bunch of grapes beneath the skin.

HYPERTROPHY OF THE BREAST

Hypertrophy of the breast is a rare condition, and is usually met with in young neurotic women, who are the subjects of amenorrhœa or some uterine affection. The condition is usually bilateral though more pronounced on one side. The breasts may attain a very large size, and, becoming pendulous, may reach to the waist; in less severe cases the organ is firm and tense and the overlying skin is stretched and shiny; the area of the areola is increased. The tissues of the gland, especially the interlobular connective tissue, are increased in amount, but do not show any other departure from the normal. Occasionally the hypertrophy diminishes with involution after lactation.

The symptoms are mechanical only; there is a feeling of weight and dragging and occasionally mastodynia.

Treatment.—The breast should be well supported by strapping, which must be tight enough to exert some pressure. The general health and the state of the uterine functions must be attended to, and tonics, especially iron, are beneficial. Iodide of potassium should be given a fair trial. If the breast is very large so that the mere bulk is a serious inconvenience, and especially if there is associated pain, amputation may be performed; when both are affected they should not be removed simultaneously.

False hypertrophy.—A breast may appear to be enlarged from an increase in the fat or connective tissue, or from the growth of a tumour. Accumulation of fat is very common after the climacteric, and the breasts of Negresses occasionally become much enlarged and pendulous from the same cause, added to lack of support in the absence of clothing.

ACUTE MASTITIS—ACUTE MAMMARY ABCESS

Etiology.—Acute inflammation and suppuration of the breast usually occurs in connection with pregnancy and especially lactation. It is essentially a disease of the poorer classes, and is favoured by want of sufficient and proper food, or any condition impairing the general health during pregnancy. Mammary abscess is more common on the right side, probably because the right breast is more used for suckling and the nipple is therefore more likely to suffer. Cracked nipple is a frequent precursor of the condition; retraction of the nipple or death of the child may both occasion abscess, no doubt because the congested state of the breast is unrelieved. Occasionally suppuration may occur as the result of injury or general embolic pyæmia. The pyogenic cocci may gain entrance along the ducts, or in the case of cracked nipple, by the lymphatics. Abscess may arise in the breasts of infants, unmarried women, or men.

Morbid anatomy.—The abscess may be quite small and situated over the breast, usually close to the nipple beneath the areola (*supramammary abscess*); or it may lie beneath the breast, probably originating in a deeply seated lobule (*submammary*); but more usually the suppuration is in the lobules of the breast itself (*intramammary abscess*). The inflammation arises round the acini of the gland, the organisms passing through their walls. Many lobules may be successively affected, and if the abscesses are allowed to burst the breast may become tunnelled and undermined with numerous sinuses which will form in the absence of free drainage.

Signs and symptoms.—The patient complains of intense throbbing pain which is aggravated by suckling, especially if the nipple be cracked. On examination the breast will be found swollen, turgid, and very tender; the skin is hot, tense, and shiny, and the cutaneous veins are engorged. The temperature is raised, sometimes to 104° F.; the patient looks and feels very ill, and the usual constitutional symptoms of fever are present. Suppuration may be ushered in by shivering and deepening of the constitutional symptoms; the skin over the abscess becomes œdematous, more tense and shiny, and where the pus approaches the surface the latter becomes dusky in colour and gradually thinned. Fluctuation is easily felt if the abscess be large, but if it be small and deeply seated this sign may be difficult of detection. In the case of sub-mammary abscess pain is increased by moving the pectoralis major muscle, and the collection of pus beneath the gland pushes it forwards so that it projects more than does the unaffected breast.

Mammary abscess may affect only one part of the breast, but other lobules may break down successively. The areolar or supra-mammary abscess does not produce such severe local or general symptoms, although the pain during suckling may be acute.

Acute mastitis does not always terminate in acute abscess, but may completely subside under treatment or may become chronic and ultimately cause chronic abscess.

Treatment.—During lactation the nipple should be carefully prevented from cracking as described on p. 695.

If acute mastitis is not very severe, prompt treatment may arrest suppuration. The patient should be directed to keep the arm to the side, and the breast supported by a sling. If the general condition of the patient permits, the child should be suckled at the healthy breast, the milk being withdrawn from the inflamed one by the breast-pump. When the inflammation is severe, suppuration imminent, and the patient in a very weak state with high fever, the child must be weaned; under such circumstances suckling will tax the mother's strength too much and her milk is unfit for the baby. The secretion of milk may be arrested by the same measures that will benefit the inflammation. The breast should be painted with glycerine and belladonna, and hot fomentations must be frequently applied; the bowels must be acted on by salines and iodide of potassium should be administered internally.

Should suppuration occur, the abscess must be freely opened by an incision radiating from the nipple, so that the ducts may not be divided if breast tissue has to be cut through. It is important to have a long enough opening to secure ample drainage, otherwise burrowing is very likely to ensue and occasion long-continued trouble, materially adding to the patient's debilitated condition. The abscess cavity should be examined with the finger to ascertain if a counter-opening is necessary. Should other lobules suppurate, and this is to be suspected if the patient's general condition does not rapidly improve, the softened patches must be freely opened. Breast-abscesses sometimes show a great reluctance to heal, especially if the function of the gland has not been arrested and milk escapes into the abscess sac. Under such circumstances the wall may be stimulated by the use of astringent antiseptic lotions or by sharp-spooning. Very rarely the cavity contracts down to a narrow sinus discharging milk (*milk fistula*).

When the breast is extensively riddled or undermined by sinuses which continually discharge pus and so weaken the patient, these should be sharp-spooned and slit up whenever this can be done without inflicting great damage.

In view of the debilitated and often half-starved condition of the patient, a plentiful and nutritious diet is essential. During the height of the mischief, while the temperature is raised, the food must consist of good beef-tea or broth, milk, and a little stimulant if the pulse is feeble and rapid. As soon as the abscess has been opened and the general condition improves, the diet must be more liberal, and when quite convalescent the patient should be given tonics and sent to the country if circumstances permit.

CHRONIC MAMMARY ABSCESS

Etiology.—Chronic breast-abscess is almost always preceded by pregnancy, whether this has gone to the full term or not. In rare cases it may be due to injury or a deposit of tubercle.

Morbid anatomy.—The abscess sac is usually small, and affects a deep-seated lobule of the gland. The wall is very thick and surrounded by condensed and indurated breast tissue; these conditions, coupled with the small quantity of pus and its thick curdy character, render the detection of fluctuation difficult or impossible. A layer of unhealthy granulation tissue lines the abscess wall. Owing to the chronic inflammation the ducts may be pulled upon and cause retraction of the nipple.

Signs.—Chronic mammary abscess closely resembles scirrhus cancer, and many breasts have been removed under this supposition. The history of previous pregnancy, the occasional œdema of the skin, and perhaps indistinct evidence of fluctuation are the leading diagnostic features; the axillary glands may be enlarged in either condition.

Cancer and deeply seated innocent tumours or cysts are usually more circumscribed than is chronic abscess, but this is of little diagnostic value. Whenever there is the slightest doubt as to the diagnosis, the surgeon should invariably cut right through the supposed tumour before sacrificing the breast.

Treatment.—The abscess must be freely opened by an incision radiating from the nipple. The wall should be cut away with scissors or freely sharp-spooned, for if the abscess is simply evacuated the density of the inflammatory tissue prevents healing.

CHRONIC INTERSTITIAL MASTITIS

Etiology.—Chronic mastitis is a very troublesome condition, and is usually met with in the breasts of childless women over forty years of age, but also often attacks younger women and girls at the age of puberty; it is occasionally met with in the male. Chronic inflammation may follow lactation or the acute form.

Morbid anatomy.—The disease is often bilateral, but is worse on one side; it usually affects only a limited portion of the breast (*lobular mastitis*), but may involve the whole. The changes are similar to those occurring in cirrhosis of other organs. The interlobular connective tissue is increased, and, microscopically, all stages in the development of fibroid tissue from round-celled infiltration may be seen. As the new tissue contracts, the glandular substance atrophies from pressure; the epithelium of the acini proliferates, becomes fatty, and is absorbed, and the acini are obliterated. Pressure on the ducts leads to the formation of retention cysts, containing clear or turbid fluid, of those acini which have escaped destruction. These cysts are very small and are chiefly seen on the under surface of the organ; they closely resemble those met with in renal cirrhosis. Such a cyst may occasionally attain the size of a walnut and be distinguishable as a definite tumour.

The affected breast is hard, dense, and leathery in consistence.

Signs.—The first sign attracting attention is pain, which is sometimes severe and may radiate over the chest or along the intercosto-humeral nerve. The pain is worse at the menstrual period and after examination of the organ, which causes the patient to flinch. The breast is somewhat enlarged, indurated, and knotty, the edge rounded and clearly defined; the skin is unaffected, but may dimple slightly when squeezed up between the finger and thumb; the nipple is not retracted. When only one lobule of the breast is affected an erroneous diagnosis of fibro-adenoma or cancer is occasionally made, and should there be a cyst of any size, the error is more likely to arise. If the palm of the hand be laid upon the breast and the organ is pressed against the chest wall, it will be evident that there is no distinct tumour. The glands in the axilla are occasionally slightly enlarged and tender. The general health remains good, but the patient is often anæmic.

Prognosis.—Chronic mastitis is a very intractable condition, but may sometimes disappear gradually, or may terminate in chronic abscess. If the patient becomes pregnant the disease may be benefited when involution follows lactation. Sometimes the condition is followed by cancer.

Treatment.—The patient should be reassured as to the innocent nature of the disease, her condition being often aggravated by the constant dread of cancer. She should be warned not to meddle with the breast, which may be covered (excepting the nipple and areola) with a belladonna or opium plaster, the use of which often gives relief. These applications, especially the former, sometimes cause considerable irritation and give rise to small pustules on the skin—a fact the patient should know. Direct pressure by means of strapping is sometimes beneficial, but should this increase the pain it must be discontinued. Any uterine trouble should receive attention, and anæmia must be treated by the administration of tonics, especially iron, good food, and change of air. Iodide of potassium occasionally does good. In persistent cases causing much trouble from pain, the affected lobule may be cut out; should an appreciable cyst be present it should be opened and allowed to granulate from the bottom, the secreting surface being swabbed over with chloride of zinc solution, grs. 40 ad ℥i. In the most severe cases, when the whole breast is affected, the patient past the climacteric, and the annoyance great, amputation may be resorted to; this, however, is very rarely required.

TUBERCLE OF THE BREAST

Tubercle of the breast is a rare condition and usually gives rise to chronic localised abscess; more rarely the breast is the seat of disseminated tubercle. It is nearly always associated with pulmonary phthisis or some other tubercular lesion. The axillary glands are often enlarged and caseous.

If localised abscess forms it should be treated by excision of the affected lobule; but when the breast is more generally diseased amputation is required.

SYPHILIS OF THE BREAST

A primary chancre is sometimes met with on the nipple, and often originates in a crack. The lesion is superficially ulcerated, localised, indurated, and painless; the axillary glands are always enlarged, indurated, and discrete. If there is much ulceration the condition may be mistaken for epithelioma, but the appearance of secondary symptoms, the history of the case, and the effect of anti-syphilitic treatment will establish the diagnosis. **Mucous tubercles** may occur round the nipple.

In the tertiary stage of the disease **diffuse infiltration**, clinically resembling the usual form of chronic mastitis, has been occasionally noticed.

Gummata may form beneath the skin or in the substance of the breast; when softening occurs the mass breaks down, leaving a circular excavated ulcer with a foul base covered with the characteristic wash-leather slough. Before this stage is reached the diagnosis from adenoma and cancer may present difficulties. From the former, gumma may be distinguished by its greater fixity, from the latter by the absence of pain or glandular enlargement, and by its being less dense; in both cases the history is of value. The treatment is that for tertiary syphilis.

TUMOURS OF THE BREAST

The connective tissue tumours are all rare. **Lipomata** are sometimes met with beneath the skin over or between the breasts, but can hardly be regarded as tumours of the breast.

The so-called recurrent fibroid is now known to be a spindle-celled sarcoma.

Myxoma, osteoma, and chondroma have been met with, but are excessively rare.

Connective tissue tumours should be removed without damage to the breast tissue.

ADENOMATA—PURE ADENOMA—ADENO-FIBROMA—ADENO-SARCOMA—CYSTIC ADENO-SARCOMA

Morbid anatomy.—These tumours, though differing in many respects to the naked eye and in their clinical characters, are all built up on the same general plan and owe their individual characteristics to modifications of growth. They are all, primarily at least, innocent, although those containing sarcomatous tissue may grow rapidly, attain a very large size, and affect the general health by fungating on the surface and eventually exhibit decided malignancy. All these tumours are encapsuled, and merely push aside, and by pressure cause atrophy of the surrounding breast tissue; in the rapidly growing forms the capsule may give way, the skin becomes implicated, and the tumour ultimately fungate on the skin.

The general anatomical structure of these tumours consists of a stroma, in which run slit-like spaces and imperfect acini lined with one or more layers of cubical epithelium and containing a little serous fluid. The epithelial cells never penetrate beyond the wall of the space they line, and hence do not grow into the stroma of the organ.

Modifications in the stroma or the spaces necessarily result in corresponding variations in the general appearance of the tumour and in its clinical characters.

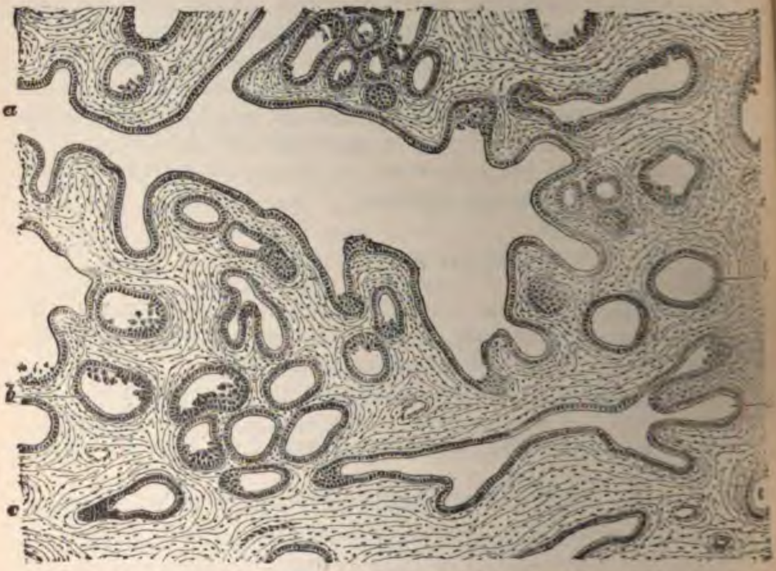

FIG 196.—Tubular adenoma of the breast (Ziegler). *a*, longitudinal section of dilated and branching tubules; *b*, cross-section of tubules; *c*, stroma.

Modifications of the stroma.—In the case of the simple adeno-fibroma, the stroma consists of fibrous tissue with a few cellular elements. If the cellular element is large in amount all gradations of development, from embryonic tissue up to fully formed fibrous tissue, are met with and the tumour is spoken of as a *soft adeno-fibroma* or *adeno-sarcoma.*

Modifications of the spaces.—The simple, slit-like spaces and imperfect acini (which are never connected with a duct as in normal breast tissue) may be dilated into cysts of large or small size (*cystic adeno-fibroma*). If at the same time the stroma is embryonic, the tumour is spoken of by some as a *cystic adeno-sarcoma*.

Not uncommonly intracystic growths grow into and completely fill a cyst; these growths are themselves exact representations of the whole tumour, consisting of stroma, spaces, and cysts which may in their turn contain growths (Fig. 197).

Such tumours are sometimes spoken of as *proliferous cysts*.

Pure adenoma is very rare and is exactly like ordinary breast tissue, except in so far that its ducts are rudimentary and have no outlet.

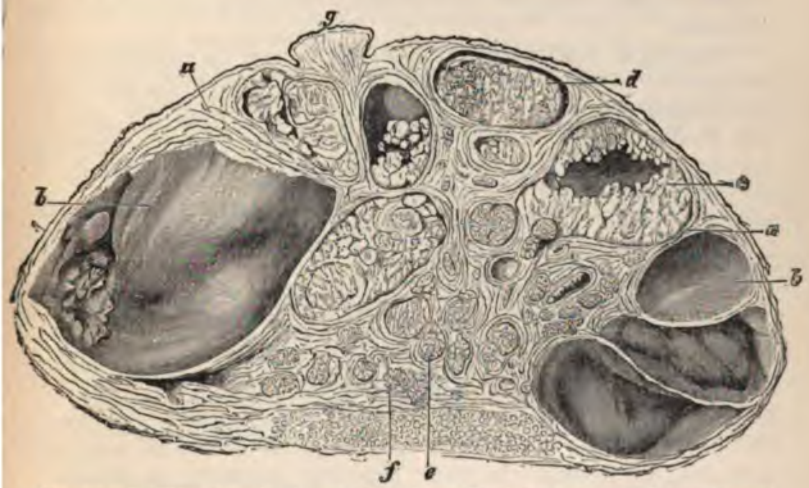

FIG. 197.—Papilliferous cystic adenoma of the breast (Ziegler). *a*, stroma; *b*, smooth-walled cysts; *c*, cysts beset with papillæ; *d*, cysts filled with papillæ; *e*, small encapsuled papillary growths; *f*, adenomatous proliferation; *g*, nipple.

Adeno-fibroma—Chronic mammary tumour.—This, the common innocent tumour of the breast, is composed of a fibrous basis, with slit-like spaces as above described. The tumour is encapsuled and quite distinct from the breast tissue, except for a small pedicle at one part; it is nodulated on the surface. On section no milky juice can be obtained by scraping as is the case in cancer, but a little clear fluid escapes from the spaces.

The cut surface is often foliated owing to the slit-like spaces, and in typical specimens resembles the heart of a cabbage.

Clinical characters.—Adeno-fibroma is usually met with in young unmarried women, and is sometimes attributed by the patient to injury. Uterine disturbance is often present, but what relation if any, exists between the conditions is unknown. The growth is usually slow, but after a time, when cellular elements form a large part of the stroma, it may become rapid. The tumour is painful during and after examination and at the menstrual period; the pain is usually slight and neuralgic in character, but may be very severe. The tumour is freely movable, and does not affect the skin, nipple, or glands; neither does it produce secondary deposits, recur after removal, nor affect the general health. It is dense but elastic to the touch, and may be confounded with a tense cyst. Occasionally adeno-fibromata disappear spontaneously or during involution after lactation.

Treatment.—No treatment but removal can be expected to do any good. To effect this the tumour should be fixed by one hand and pressed well against the skin, which is thus stretched over it. The knife is made to cut into the growth, so that the investing connective tissue is with certainty opened, and if the pressure on it be maintained while the incision (which must radiate from the nipple) is made, the tumour readily shells out; the small pedicle is then divided, and the wound cleansed and closed without drainage. The capsule need not be removed.

Adeno-sarcoma or soft adeno-fibroma.—The only difference between this tumour and the simple adeno-fibroma is that the stroma is largely composed of embryonic or imperfect fibrous tissue, and on microscopic examination round, oval, and spindle cells are found to be numerous, the rate of growth is consequently increased, and in some cases the tumour may attain an enormous size, and even fungate through the skin, retaining, however, its innocent nature. The tumour may be rapid of growth from the first, or a simple adeno-fibroma may assume its clinical characters. There is usually no pain. An adeno-sarcoma is often cystic, and may be myxomatous.

Treatment.—When the growth is small the treatment is the same as for adeno-fibroma, but if it has attained a large size amputation of the breast is required.

Cystic adeno-sarcoma or cystic adeno-fibroma.—This growth differs from the preceding only in the presence of cysts of considerable size, which may contain intracystic growths that sometimes completely fill them. The clinical history is the same; the tumour is soft, and may have grown quickly from the first, or may have originated as a simple adeno-fibroma which, having been present and practically stationary for a long time, has suddenly increased with rapidity. The presence of cysts may be easily recognised, but the soft stroma often gives a false sense of fluctuation.

Treatment consists in removal of the tumour, or amputation of the breast according to the size the former has attained.

SARCOMA OF THE BREAST

Morbid anatomy.—Pure sarcoma is usually of the spindle-celled variety, but the round-celled is not uncommon. Myeloid, alveolar, and myxo-sarcoma are also occasionally met with. The tumour is encapsuled, but as it increases in size the capsule may yield and the growth spread throughout the breast, or implicate and fungate through the skin. Cysts due to degeneration and softening, or to hæmorrhage within the tumour, are common; but there is no epithelial lining to the cyst wall as in the adeno-sarcoma.

Clinical characters.—Sarcoma is usually met with between the ages of thirty and forty. It may grow slowly for a time, or quickly from the first, the rate of growth being proportional to its softness.

The density of the tumour varies; sometimes the spindle-celled form is as hard as a fibroid tumour, or the growth may be so soft that it appears to fluctuate.

The tumour is usually rounded, lobulated, and circumscribed, unless the capsule has yielded. The nipple is not retracted, and the axillary glands are but rarely involved. Sarcoma may attain an enormous size, and tends to recur locally and in the viscera after removal.

The diagnosis between sarcoma and soft glandular cancer or adeno-sarcoma is often impossible before removal and microscopic examination.

Treatment.—The breast must be completely removed, but the axilla need not be cleared unless the glands are implicated. In some instances, where the rate of growth is slow, and the tumour dense and quite localised, it may be removed without sacrificing the breast; but the case should be carefully watched, and the whole organ amputated should a recurrence take place.

CANCER OF THE BREAST

Etiology.—Cancer of the breast rarely occurs before forty years of age, but when it does so is apt to run a rapid course.

The condition is often attributed by the patient to injury, or there is a history of some antecedent inflammation of the organ; breasts which are the seat of chronic mastitis may become cancerous. The frequent association of cancer with Paget's disease of the nipple seems to be more than accidental, and it is probable that the irritation caused by the latter excites epithelial overgrowth and invasion of the tissues and lymphatics by the epithelial elements. Cancer of the breast is relatively more common in married than in single women. For further information regarding the etiology of cancer generally, see p. 222, vol. i.

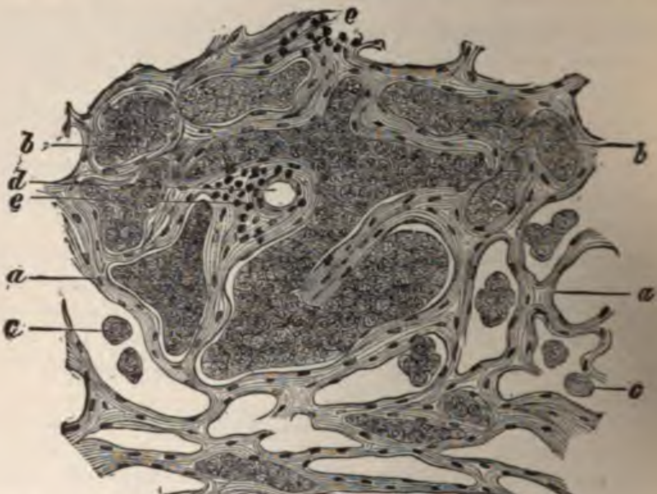

FIG. 198.—Scirrhous carcinoma of the breast (Ziegler). *a*, stroma; *b*, loculi filled with epithelial cells; *c*, isolated cancer cells; *d*, blood-vessel; *e*, cellular infiltration of the stroma.

Hard glandular cancer or scirrhus.—Scirrhus is far more common than any other variety of cancer, and usually occurs in the nodular form. At first there is a small, very hard, rounded, localised but not encapsuled tumour, which may be situated in any part of the breast, and is not adherent to the skin or deeper structures. As the mass increases in size, implication of the surrounding tissue leads to fixity and perhaps to destruction of the skin and ulceration (Fig. 202, p. 686). The axillary glands are speedily affected, and later on the disease spreads to those above the clavicle. On section the tumour is seen to be localised, but processes spread from it into the surrounding fat along the fibrous bands. The tendency to contract (due to atrophy of the cells) is shown by the cupping of the cut surface, by the drawing in of the pectoral muscle, and by retraction of the nipple. The surface is greyish in colour, and flecked with dots and lines of yellow (due to fatty degeneration of the epithelial cells), so that it closely resembles the section of an unripe pear or turnip.

Spreading to the skin, the growth may (with or without ulceration) invade it for a considerable distance, either by continuity or by the confluence of isolated nodular patches of cancer; the skin is thus rendered hard and leathery, and its natural suppleness is lost.

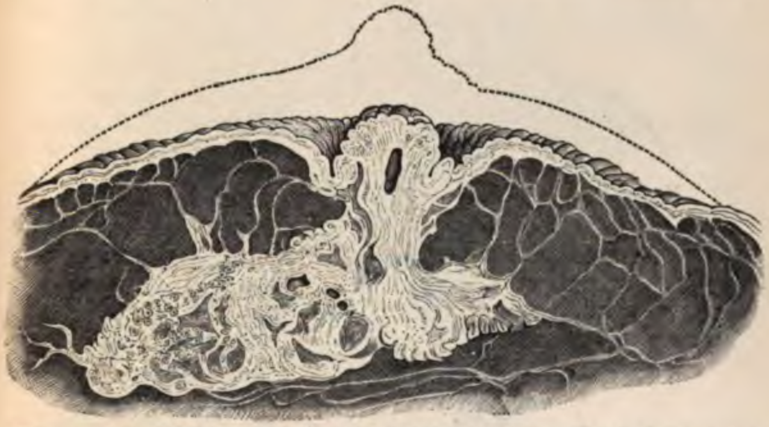

FIG. 199.—Cancer of the breast; the dotted line indicates the extent to which the nipple and areola have retracted (Bland Sutton).

In some cases the main feature of the growth is this extensive invasion of the skin, which may be involved over the greater part of the thorax (*cancer en cuirasse*, Fig. 200, p. 684).

Sometimes the cancer involves the whole breast, simulating to some extent the condition of chronic mastitis (*diffused or infiltrating scirrhus*). Such cases usually progress rapidly, and involve the glands and internal organs early; the growth is very rich in cells, and hence soft in consistence, and less likely to give evidence of contraction.

Atrophic or *withering scirrhus* is a rare manifestation of the growth met with in aged women, and characterised by a tendency to extreme contraction, so that the affected parts are much puckered (Fig. 201). The disease in such cases may last for many years, the patient suffering little or no inconvenience, and dying of some other complaint.

Secondary deposits of cancer not only occur in the glands, but in the internal organs, especially the liver and lungs. The growth may invade the chest wall and spread through it to the pleura, and may also be met with in the bones.

Signs.—The patient's attention is first drawn to the breast by some little pain, or she casually discovers the tumour while washing.

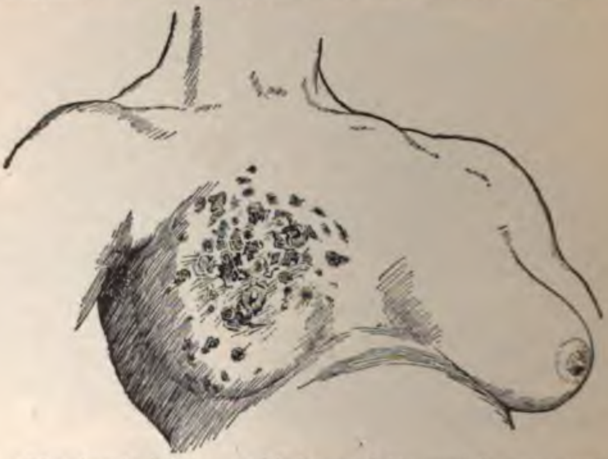

FIG. 200.—Disseminated scirrhus cancer of the breast and skin over it (*cancer en cuirasse*) (drawn by C. H. Freeman).

Pain is usually slight and of a neuralgic character, but as the disease advances may be very severe, and radiate over the chest, or extend down the arm, especially if the axillary glands are extensively involved. The mass is of stony hardness, quite localised, and at first freely movable; but later on it becomes adherent to the pectoral muscle and to the skin. If it is situated close to the nipple the latter is markedly retracted (Fig. 199, p. 683), but if at the periphery of the breast the nipple may remain unaltered, since the ducts are not involved. On approaching the skin the traction on the fibrous septa causes it to dimple, and subsequently ulceration may follow its invasion. The appearance of the ulcer is characteristic: its floor is usually depressed beneath the level of the skin, but if the growth of the tumour is rapid an exuberant bleeding fungus may sprout from it. The floor may be fairly clean and covered with unhealthy granulations, or—especially if the patient has neglected it—may be very foul and covered with slough. The edges of the ulcer are everted and abrupt, and the whole mass is dense and indurated.

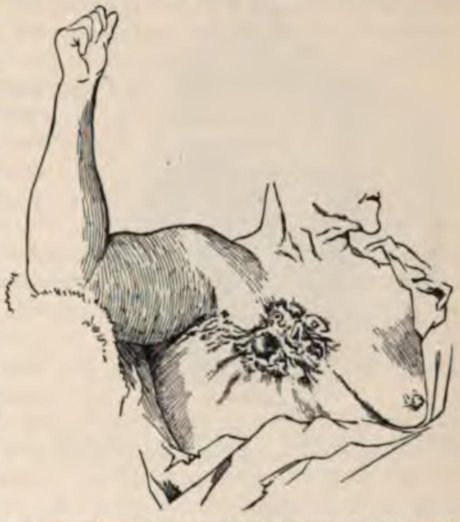

FIG. 201.—Atrophic scirrhus of the breast of eight years' duration. The seat of the growth is much puckered, and the arm swollen from pressure on the axillary vessels by the cicatricial tissue and lymphatic involvement (drawn by C. H. Freeman).

The superficial veins are often congested and plainly visible. Enlarged glands may be felt in the axilla, but it is important to remember that these may be concealed in the fat, and so escape detection, and, moreover, that they are cancerous before attaining a sufficient size to be readily felt. There may be considerable swelling of the arm, causing pain and congestion, due to pressure on the axillary vein by the enlarged glands.

The patient gradually declines in health, becoming pallid, emaciated, and cachectic, and should there be deposits in the internal organs she may exhibit symptoms of their presence.

Diagnosis.—Nodular scirrhus may be confounded with adenoma, chronic abscess, or a deeply seated and tense cyst. The first and last may usually be eliminated by a little care: the age of the patient, the gradual growth, free mobility, marked circumscription, and freedom of the glands, nipple, and skin, coupled with the absence of constitutional cachexia in these conditions, usually being sufficient. From chronic abscess the diagnosis is far more difficult, and has been discussed on p. 674.

It is a golden rule of surgery never to amputate a breast in cases in which there is the least doubt as to the nature of the tumour, before an incision has been made into it, and the diagnosis thereby rendered certain.

Infiltrating cancer may be mistaken for chronic mastitis, and indeed sometimes supervenes on that condition. Rapidity of growth and glandular enlargement are important diagnostic features. In cancer the mass is single, but in mastitis several lobules are often enlarged.

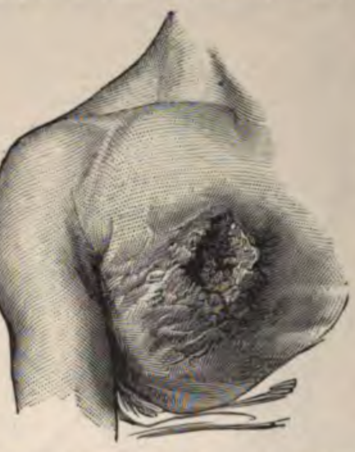

FIG. 202.—Ulcerating scirrhus of the breast with invasion of the surrounding parts (Follin).

Soft glandular cancer (encephaloid).—Soft cancer differs from scirrhus merely in the relatively large proportion of epithelial cells to the fibrous stroma, in its greater vascularity, more rapid growth, and tendency to infiltrate the whole breast, and the consequently slight degree of contraction (evidenced by dimpling of the skin and contraction of the nipple) which it occasions.

When it has invaded the skin the tumour fungates, and gives rise to a foul, sloughy fungus, which rapidly increases in size, and may be the seat of repeated and profuse hæmorrhage. Softening and degeneration, with interstitial bleeding, may give rise to cystic cavities in the growth.

This form of cancer recurs rapidly after removal, speedily reproduces itself in internal organs, and is more quickly fatal than is the hard form. Soft cancer is more likely to occur if the patient be young. The general diagnostic features are similar to those of sarcoma, but the glandular enlargement usually serves to differentiate the two.

Colloid cancer.—Colloid cancer is the term applied to the glandular variety (usually of the softer kind) in which this form of degeneration has occurred. It is very rare, and the conditions leading to the change are unknown.

The colloid change does not affect the whole growth, considerable portions of which, especially at the periphery, remaining unaffected; the degenerated cells are ultimately entirely replaced, in the affected area, by colloid material enclosed in the distended fibrous alveoli. Although the tumour increases in size, it does so slowly, and its malignancy is comparatively slight.

Clinically the existence of colloid is practically never recognised until the breast has been removed.

Duct or villous cancer.—Duct cancer is a rare and not very malignant form, characterised anatomically by the presence in the growth of true cysts formed by dilatation of the ducts, which are lined by short columnar epithelium, and contain delicate vascular papillomatous processes. The main bulk of the tumour is similar in structure to a soft glandular cancer. This form of growth originates as a duct papilloma (see Fig. 206, p. 693), the epithelium which covers the papillary processes proliferating and penetrating the deeper structures. The delicate and vascular processes may be the source of hæmorrhage which distends the cysts, and which, escaping from the nipple, is of diagnostic value. In any given case it is impossible to say whether the condition for which the patient seeks advice is really carcinomatous, or merely cystic disease with papillomata, and consequently an exploratory incision is advisable; although when the latter condition is advanced amputation is the best course.

The axillary glands are not often involved, and secondary deposits only occur late.

This form of cancer closely resembles in its general features the tumour-like masses found in rabbits' livers as the result of coccidium disease, and some contend that the breast affection is really due to this cause.

Duct cancer is sometimes associated with Paget's disease of the nipple, which is also attributed by some to coccidia (see p. 696).

Prognosis of cancer.—Speaking generally, it may be said that cancer of the breast proves fatal in from two to four years; but all forms are not equally serious in this respect. Soft glandular cancer is the most rapidly fatal, scirrhus standing about midway between it and villous or colloid cancer. Atrophic scirrhus may last for many years. The occurrence of pregnancy and functional activity of the gland increases the rapidity of growth in all forms. The prognosis at the present day is, in view of early and accurate diagnosis and of complete operations, much more hopeful than it was twenty years ago.

Treatment.—The only resource is amputation of the whole breast and removal of the axillary glands. Amputation alone without interference with the axilla may be performed if the operation is undertaken merely with the view of relieving the patient from an ulcerating, foul, and painful mass without any hope of cure.

In certain cases no operation, however extensive, offers a reasonable hope of permanent cure; and although some surgeons have advocated and practised most heroic operations in such cases, I cannot think that their zeal has been tempered by judgment. When the axillary glands are enormously enlarged and obviously involve artery, vein, and nerves, it will be found that the glands above the clavicle are also infected; such cases should be left alone. Secondary deposits in the viscera, wide infiltration of the skin, and the presence of any other serious disease, are also contra-indications for operation.

Oöphorectomy has recently been recommended in the treatment of inoperable cancer of the breast or of its recurrences locally. Stanley Boyd has collected fifteen cases in which the operation was performed with varying success. A study of these tends to show that in some cases good results were undoubtedly obtained, although none can be said to have been cured; in other cases the benefit was doubtful, and in a third group none can be said to have followed the operation. At present it is impossible to estimate its real value or to make a selection of cases in which it may or may not do good, but it may provisionally be pointed out that the most hopeful cases appear to be those in which the operation is performed before the climacteric in middle-aged women in whom the cancer is but slowly increasing; after the menopause, but little good is to be expected from the operation. Oöphorectomy apparently acts beneficially by removing the "internal secretion" of the ovaries, which secretion presumably in some way favours cancerous growth. Thyroid extract has been administered at the same time, but its influence appears to be *nil*. With regard to removal of the ovaries it must by no means be regarded as a general therapeutic measure, and in any case in which the surgeon contemplates it, the facts must be clearly explained to the patient and the decision left in her hands.

REMOVAL OF THE BREAST

At the present day the operation for the removal of a cancerous breast is much more extensive and severe, and gives better results, than was formerly the case. It involves the removal of the entire skin covering the prominent part of the gland, and in some cases even more widely than this, of all outlying glandular lobules, of the superficial fibres of the pectoral muscle, and sometimes of one or both pectorals themselves, together with the complete removal of the axillary fat and glands right up to the clavicle. An even more extensive proceeding has been recommended by Halsted, who advises that in all cases the supra-clavicular region should be opened up and all the fat and glands removed, as in the case of the axilla. He further suggests that in the near future it may be deemed advisable to remove at the primary operation the mediastinal fat and glands. But I venture to think that few English surgeons would entertain the propriety of such a proceeding in view of the facts that if the mediastinal contents be not diseased their removal is uncalled for, and that if disease has already spread in this direction cure is practically impossible. All the tissues which are to be removed should if practicable be removed in one piece, so that not only may the cancerous breast and the obviously enlarged glands be taken away, but the lymph paths extending from the one to the other may also be completely removed (Figs. 203, 204, 205).

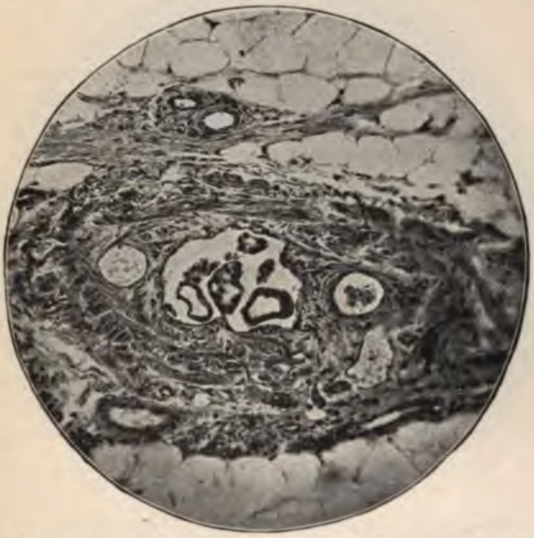

FIG. 203.—Small cancerous emboli which have been washed into an axillary lymphatic trunk (Stiles, *Brit. Med. Journ.* 17th June 1899).

The operation, as above indicated, is necessarily a serious proceeding. It occupies a long time, but in spite of this does not occasion very marked shock, for if care be taken the patient loses but little blood, and the excellent results which follow and the diminution in the number of recurrences and the increase of permanent cures fully warrant its being undertaken.

Operation.—The axilla should be previously shaved and the whole area of operation and the parts for some distance round should be thoroughly cleansed in the manner described in the chapter on Antiseptic Operations, vol. ii. The arm is abducted to a right angle, and held by an assistant or fixed in that position by a bandage passing round the wrist and tied to the leg of the table. The skin incisions must be free and include the whole of the skin covering the breast. The lower incision is made first and is carried well up into the axilla. The lower part of the skin is then reflected downwards so that the lower limit of the breast is clearly defined, and towards the axillary end the skin is reflected backwards. The breast and superficial fibres of the pectoralis major are now reflected upwards from below. The upper incision passes round the upper limit of the breast, over the anterior fold of the axilla close to the tendon of the pectoralis major to join the axillary end of the lower incision. The upper part of the skin is then reflected until the limits of the breast have been reached, and the whole organ is then turned outwards towards the axilla. If the growth has invaded the pectoral muscle the sternal part of it must be completely cut away with the breast and should be divided externally

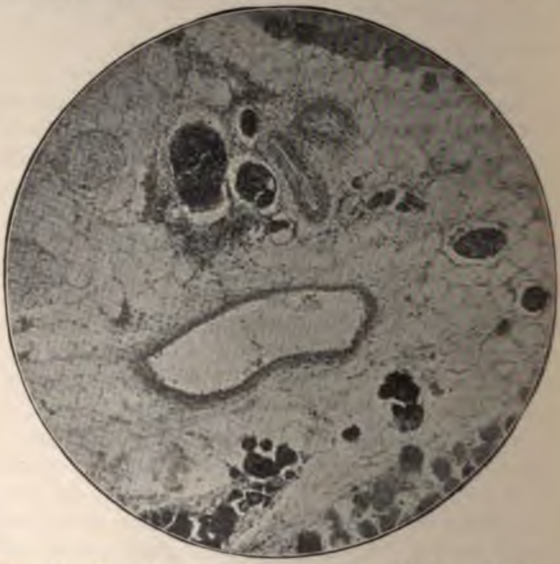

FIG. 204.—Cancer in efferent lymphatics accompanying the blood-vessels and nerves which traverse the pectoralis major on their way to supply the mamma (Stiles).

close to the axillary vessels. The axilla is now cleared, the fascia covering the muscles removed, and the fat and glands are carefully peeled off the axillary vein. The apex of the axilla may be fully exposed by division of the clavicular head of the pectoralis major and the pectoralis minor, and if enlarged glands are found lying on the latter it must be completely excised. If the glands are found to be intimately connected with the axillary vein, it must be clamped above and below the area of involvement, and the portion removed. As a rule œdema of the arm does not result from this proceeding, and even should it do so the œdema is usually slight and transient. The subscapular nerves may sometimes be saved, but if cancerous tissue is found in immediate proximity to them they should be sacrificed. When the whole mass of disease has been removed the pectoralis minor if it has been divided, but its removal has not been thought necessary, should be sutured. If it is thought necessary to clear out the supra-clavicular fossa, this should be freely opened up by an incision above the clavicle, and the fat and glands completely removed, every care being taken that the vessels and nerves are not damaged. The necessity of this extension of the operation must be determined

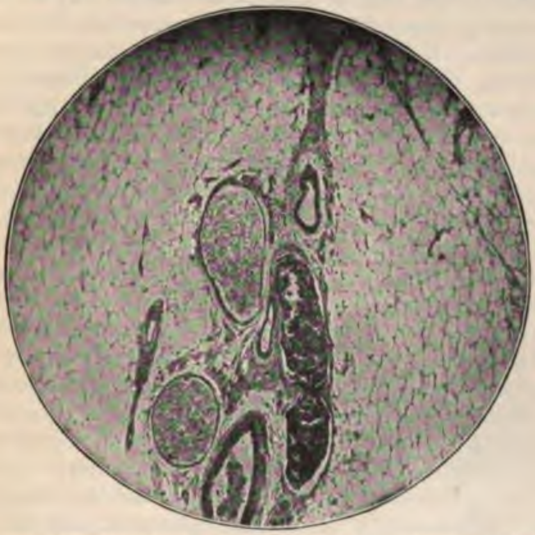

FIG. 205.—Cancer in a lymphatic vessel occupying one of the connective tissue "claws radiating from the edge of the tumour into the surrounding fat towards the axilla (Stiles).

by the condition of the axilla—if the glands are invaded up to the clavicle the larger operation should be performed. During the operation that part of the wound which has been finished should be kept covered with gauze or lint wrung out in hot sterilised water, for this materially diminishes the shock. The arm is now brought down to the side and an endeavour made to bring the wound together. For this purpose numerous points of suture are necessary in order that the strain which, owing to the very free removal of the skin, must be great, may be distributed widely. By this plan it is often surprising how a wound may be completely, or almost completely, closed. If it is found impossible to unite the wound in its whole extent, the unclosed portion may be at once grafted by Theirsch's method, the grafts being taken either from the thigh or from the shoulder, but the grafting may be postponed until the wound is granulating. A drainage tube in the axilla for the first few days will drain away the serum which is exuded from the cut surfaces. There will be no necessity to dress the wound merely to remove the tube, so that if all goes well the dressings may be left untouched for a week or ten days. At the end of ten days the sutures may be removed.

In dressing a case of removal of the breast care should be taken to thoroughly protect the axilla, and the dressings should be placed well over the back and shoulder. The first bandage should be passed round the chest beneath the arm so that equable pressure may be exercised on the wound, and all parts of it thus brought in contact. When this has been done a spica for the shoulder should be carefully applied; the arm is then slightly abducted and fastened to a pillow by a broad bandage: this plan will be found most comfortable and does away with much subsequent stiffness. It is of great importance that the patient should be kept under constant supervision for at least three years subsequent to the operation, so that if any suspicious nodules should appear they may be immediately submitted to operation which should be as extensive as circumstances permit.

CYSTS OF THE BREAST

Varieties.—Some forms of cyst are very common, others exceedingly rare. The following are the varieties met with :—

1. Cysts due to dilatation of the ducts or acini (retention cysts).

(*a*) *Retention cysts* containing clear fluid may form in the acini as the result of pressure on the ducts by the new tissue formed in chronic mastitis (p. 675). These cysts are usually quite small, but occasionally one may be large enough to form a definite tumour. Similar cysts may also develop in breasts undergoing senile involution (p. 671).

(*b*) *Galactocele* is a cyst containing milk, due to its retention behind an obstructed duct. The obstruction may be consequent on inflammatory thickening of the tissue outside the duct. Galactocele is rare; it may attain considerable size, and on squeezing it a little thick milk may be expressed from the nipple, provided the obstruction of the duct be not complete. It of necessity always occurs in connection with lactation, and gradually increases in size, usually without causing pain. After a time the milk becomes thick from absorption of some of the fluid part. Suppuration may occur and will be accompanied by the usual signs of acute abscess.

The cyst should be laid freely open and allowed to granulate from the bottom. Simple aspiration is unsatisfactory, since the milk re-accumulates.

(*c*) *Duct cyst—Duct papilloma.*—Partial or complete obstruction of a duct, together with an abnormal secretion from the acini in connection with it, leads to the formation of a cyst which may attain a considerable size and is composed of a wall of vascular fibrous tissue lined by columnar epithelium. Such cysts are frequently multiple, so that the whole breast is riddled with cavities and its normal appearance quite destroyed; the cysts may be situated in any part, superficial or deep, central or peripheral. Delicate vascular papillomatous growths covered by columnar epithelium, not infrequently spring by a narrow pedicle from some part of the cyst wall, and more or less completely fill the cavity; injury of these may lead to hæmorrhage. These growths are sometimes the starting-point of duct or villous cancer (see p. 687).

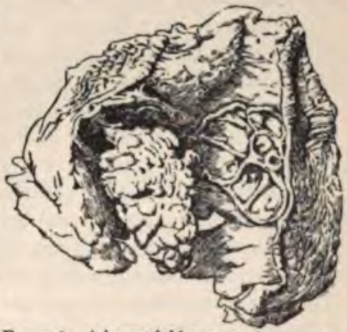

FIG. 206.—A breast laid open to show numerous cystic cavities due to dilatation of the ducts. From the wall of one of the cysts a pedunculated papilloma is growing. The nipple is retracted from traction on the ducts (Westminster Hospital Museum, No. 1106. Drawn by C. H. Freeman).

Duct cysts are usually met with after thirty-five years of age, and produce a definite tumour of the breast which is usually painless and grows slowly. On squeezing the tumour, fluid may be expressed from the nipple provided the duct is not completely obliterated. Such fluid is usually thick, straw-coloured, or blood-stained and rusty.

The treatment consists in opening up the cyst, and removing it completely if any intracystic growth be found. If the breast is extensively affected by the disease, or if it is rapidly increasing in size, it should be removed; for under such circumstances it is a useless organ, and may have developed, or possibly will develop, malignant properties from the invasion of the breast tissue by the epithelium covering the papillomatous growths.

2. Cysts formed by dilatation of the lymph spaces (**simple serous cysts**).

These cysts are uncommon. They are composed of a fibrous wall lined by flattened endothelium, in place of the columnar epithelium lining duct cysts; unlike the latter they never contain intracystic growths. They are often situated deeply, and may attain a considerable size (*hydrocele of the breast*). The fluid contents are usually clear, but may be turbid or even bloody; the fluid cannot be expressed from the nipple since the cyst has no communication with the acini or ducts.

The wall may be very dense or even calcified, and when the cyst is deep-seated its hardness may lead to the supposition that the tumour is cancerous—a doubt to be cleared up by free incision.

3. Hydatid cysts have been occasionally met with, the diagnosis depending on the nature of the fluid withdrawn.

4. Dermoid cysts have been recorded.

General clinical characters of cysts of the breast.—Cysts of the mamma may be situated in any part of the organ. They slowly increase in size, are usually painless, do not implicate the structures among which they grow, nor affect the general health. They are quite localised and have a rounded outline. They may have a feeling of elasticity or fluctuate distinctly; but when the walls are thick, the tension of the fluid high, or the cyst deep-seated, it may closely resemble a solid tumour—a mistake to be avoided by free incision.

Galactocele may be diagnosed by its occurrence during lactation and the possible escape of milk from the nipple when the tumour is compressed. Duct cysts may similarly be partially emptied through the nipple, and the presence of intracystic growths is highly probable if the fluid is blood-stained. The escape of fluid is accompanied by a corresponding diminution in the density and size of the tumour, which may sometimes be completely emptied through the nipple. A duct cyst may also be recognised by its obvious connection with the duct, which may be ascertained by fixing the tumour with one hand and pulling on the nipple with the other, a distinct "tug" being felt; if the tumour be now released it will be drawn forward when the nipple is pulled upon.

All cysts may suppurate and give rise to the signs of acute abscess.

General treatment.—Simple cysts, when causing trouble, should either be dissected out or laid freely open and the interior swabbed out with chloride of zinc solution (grs. 40 ad ℥i.) to destroy the secreting surface. Simple aspiration is useless.

Duct cysts with intracystic growths demand removal as above stated.

Diseases of the Nipple

RETRACTION

Owing to faulty development the nipple may be depressed below the level of the areola. If lactation occurs the child is unable to suck, and hence considerable engorgement and inflammatory trouble may result. Under such circumstances the nipple should be drawn out before the child is born. This is easily done by placing a cupping-glass (which has been previously heated) over the nipple. As the glass cools the air condenses, and a partial vacuum is formed, so that the nipple is gradually drawn out. This treatment, repeated daily, will soon remedy the defect.

Retraction may be induced by any pathological change (notably scirrhous cancer) which causes tension on the ducts (Fig. 199, p. 683). An appearance of retraction is also sometimes produced by inflammatory swelling or œdema of the areola, which rises up and surrounds the nipple.

ULCERATION—CRACKED NIPPLE

This very painful condition is due to the fact that the nipple is not kept clean and dry after suckling, and is often excited, or at least aggravated, by the presence of sour milk in the child's mouth. It may be the starting-point of breast-abscess, the pyogenic cocci finding their way along the lymphatic paths.

Cracked nipple ought to be prevented. The nipple should be prepared for suckling by hardening it with spirit lotion or eau-de-

Cologne. After suckling, the nipple must be carefully cleansed, thoroughly dried, and painted with glycerine or collodion; if the latter is used it should not be applied to the summit of the nipple. Before and after suckling, the child's mouth should be cleansed with a piece of soft rag. Should excoriation result the nipple must be treated with some astringent preparation, such as tannic acid glycerine, which must be carefully washed away before the child is again put to the breast; the nipple may be protected by the use of a shield. In bad cases the ulcer should be touched with silver nitrate, which causes considerable pain, or the child must be taken altogether from the affected breast.

SYPHILITIC AFFECTIONS

The primary chancre is sometimes seen (p. 169, vol. i.), and mucous tubercles are not uncommon.

PAGET'S DISEASE—CHRONIC ECZEMA

Chronic eczema of the nipple is sometimes met with, but is not identical with the condition known as Paget's disease. The latter is a superficial inflammation characterised by infiltration of the areola and epithelial overgrowth. The surface is red, tender, and raw, and exudes a yellowish, sticky discharge which, coagulating on the surface, leads to the formation of crusts. There is considerable irritation, but no pain.

Paget's disease is very persistent, and may last indefinitely in spite of all treatment. It is often associated with cancer (see p. 682), apparently causing irritative overgrowth of the epithelium by direct extension along the ducts. Some consider that the cancer is the primary affection, the discharges from the nipple producing the dermatitis. In many cases the cancer is, however, certainly secondary, and Paget's disease may have been present for a long time without the occurrence of cancer. Certain bodies closely resembling, if not identical with, coccidia have been found in connection with this condition. Whether they really are psorosperms, as is maintained by many, or whether they owe their origin to cell-degeneration or inclusion, is as yet undetermined.

Treatment.—When the diagnosis is fully established, the breast should be removed, in view of the probable supervention of malignant disease.

EPITHELIOMA OF THE NIPPLE

Squamous epithelioma occasionally attacks the nipple and areola, and may begin as a fissure or flattened indurated papule. The progress of the case is similar to that of epithelioma elsewhere. The early occurrence and gradual spread of ulceration may completely destroy the nipple, and by advancing to the areola and adjacent skin may occasion considerable loss of substance. The floor of the ulcer (which may penetrate the breast substance) is irregular, often sloughy, and covered with unhealthy granulations, which discharge a sanious fluid. The edges are raised and everted, and the area of disease is much indurated. The axillary glands are infected early, but visceral deposits are extremely rare.

The **treatment** is that applicable to other cancers of the breast (p. 687).

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